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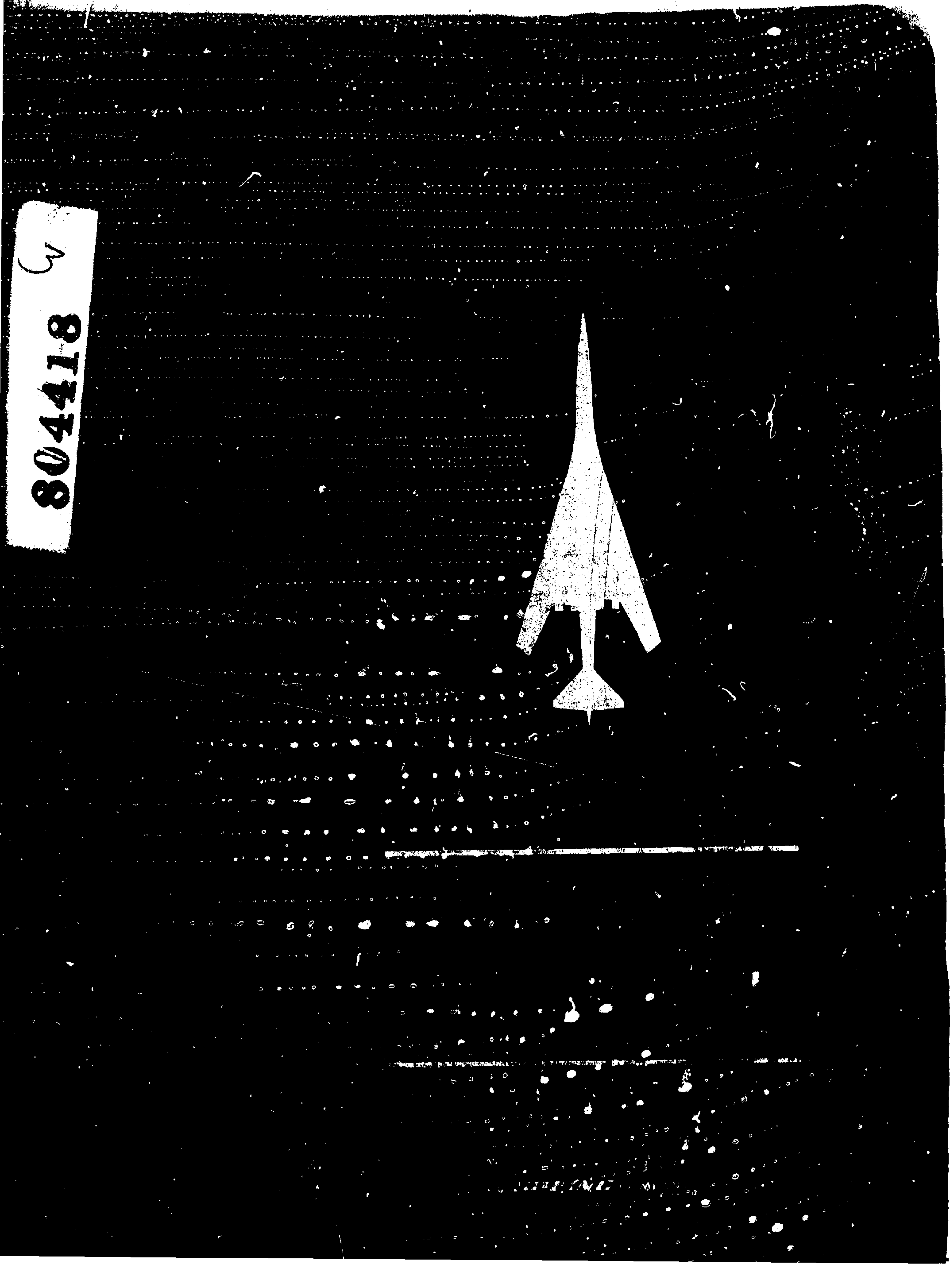
AUTHORITY

FAA notice, 2 Jul 1973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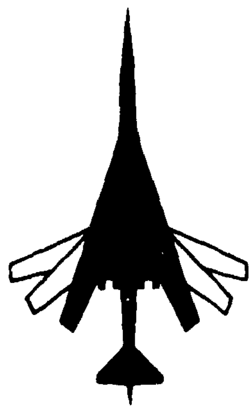

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# MODEL SPECIFICATION

## SECTION I

•

## AIRCRAFT CHARACTERISTICS AND SYSTEM REQUIREMENTS

COMMERCIAL
SUPERSONIC TRANSPORT
PROGRAM

•

PHASE II-C
INTERIM AIRCRAFT PERFORMANCE
ASSESSMENT REPORT



**COMPLETE REVISION NOVEMBER 15, 1965**
**REVISED DECEMBER 6, 1965**
**CONTRACT -FA-SS-66-5**

**THE BOEING COMPANY**
**RENTON, WASHINGTON, U.S.A.**

**D6-17850**



5

MODEL 733 DOCUMENT NO. D6-17850

TITLE MODEL SPECIFICATION - SECTION I

| REVISIONS | | | | | | ADDITIONS | |
|---|---|---|---|---|---|---|---|
| PAGE | DATE | PAGE | DATE | PAGE | DATE | PAGE | DATE |

Document completely revised in response to Phase II-C requirements outlined in FAA letter of July 1, 1965, Gordon M. Bain to M. L. Pennel, Major changes as follows:

Supplement 1 of D6-17850 changed from describing the 733-363 Transcontinental to describing the Pratt and Whitney powered 733-373 Intercontinental.

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Document completely revised to reflect the 733-390 configuration (Reference Category I Change Number 1). November 15, 1965

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Document revised to add Supplement 2 which describes the Model 733-394.

| REVISED PAGES | ADDED PAGES |
|---|---|
| iii | Supplement 2 (Complete) |
| 1 | |

November 17, 1965

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Document revised to add performance guarantees for the Model 733-394.

REVISED PAGES

S2-1

S2-5

December 6, 1965

THE BOEING COMPANY

# CONTENTS

## SECTION I

## AIRCRAFT CHARACTERISTICS AND SYSTEM REQUIREMENTS (D6-17850)



## SECTION II

## PERFORMANCE GUARANTEES (D6-17850-1)

# INTRODUCTION

This Specification, including Supplements S-1 and S-2, describes the Boeing Model 733-390 Intercontinental, powered by General Electric engines, the Boeing Model 733-394 Intercontinental, powered by Pratt & Whitney engines, and the Boeing Model 733 Prototype supersonic transport airplanes. The production configurations presented herein are the basic intercontinental models designed for airline operation. The Specification has been prepared to describe the current Boeing supersonic transport configuration and is submitted for the November 15, 1965 Phase II-C Interim Aircraft Performance Assessment of the United States SST Program. The Specification has been arranged in a typical commercial format. R R

Items such as electronic equipment, emergency equipment, galleys, and passenger seats, which are normally Buyer-Furnished Equipment in production airplanes, are included as Seller-Furnished Equipment in this Specification. However, in keeping with present practice, airlines may prefer to furnish certain equipment items for their supersonic transports. Adjustments for such changes from Seller-Furnished Equipment to Buyer-Furnished Equipment will be determined during contract negotiations with the individual airlines.

Section I of this document, D6-17850, together with the Performance Guarantees contained in Section II (Document D6-17850-1), defines the current configuration.

The Model 733-390 airplane differs from the Model 733-362 airplane described in the previous issue of this document dated July 20, 1965 in the following major respects:

- The aft body section upsweep is eliminated and the horizontal tail moved downward below the engine exhaust. This configuration was developed to improve longitudinal stability and the temperature environment of the horizontal tail.
- The landing gear has been lengthened as a result of lowering the horizontal tail.
- A retractable tail wheel has been added as a ground attitude limiting device. The tail wheel replaces the skid formerly incorporated as part of the ventral fin.
- The relationship of engine inlet to landing gear has been improved.
- Numerous miscellaneous refinements resulting from coordination with the FAA and the airlines have been incorporated.
- As a result of the above changes, the maximum design taxi and landing weights increased 10,000 pounds, the lift-to-drag ratio decreased slightly, and operational empty weight increased.

# 1.0 GENERAL AIRPLANE DESCRIPTION

CONTENTS



ILLUSTRATIONS

# 1.0 GENERAL AIRPLANE DESCRIPTION

1.1 DESCRIPTION

This Specification describes a supersonic transport monoplane having a variable position wing. Its general arrangement and inboard profile shall be substantially as shown in Figs. 1-1 and 1-2.

1.2 TYPE AND PURPOSE

A four engine, land based, supersonic airplane for commercial transportation of passengers and cargo.

1.3 SELLER'S NAME AND MODEL NUMBER

Boeing Model 733-390 Intercontinental powered by General Electric engines.

1.4 DESIGN WEIGHTS

See Par. 2.15 for definitions.

1.4.1 Structural Design Weights

| | |
|---|---|
| Maximum Design Taxi Weight | 510,000 pounds |
| Maximum Design Flight Weight (Flaps Up) | 503,000 pounds |
| Maximum Design Landing Weight | 330,000 pounds |
| Maximum Zero Fuel Weight | 287,000 pounds |

1.4.2 **Allowable Payload**

57,500 pounds
51,985 pounds (space limited), based on 239 passengers at 165 pounds each, plus 12,550 pounds of cargo and baggage.

1.5 CAPACITIES FOR CREW, PASSENGERS, AND CARGO

1.5.1 Crew

Captain
First officer
Flight engineer
Observers (2)
Cabin attendants (5)

1.5.2 Passengers (Basic Intercontinental Arrangement)

| | |
|---|---|
| 20 | First class passengers at 40-inch seat row pitch |
| 180 | Tourist class passengers at 34-inch seat row pitch |
| 200 | Total passengers |

(See Par. 11.2.2 for other interior arrangements)

1.5.3 Cargo

| | Approximate Usable Volume (Cu. Ft.) | Approximate Total Wetted Volume (Cu. Ft.) |
|---|---|---|
| Upper Compartment (Class D) | 718 | 751 |
| Lower Compartment (Class D) | 537 | 596 |
| Total | 1255 | 1347 |

D6-17850

## 1.6 DIMENSIONS AND AREAS (APPROXIMATE)

See Fig. 1-1 for major external dimensions.

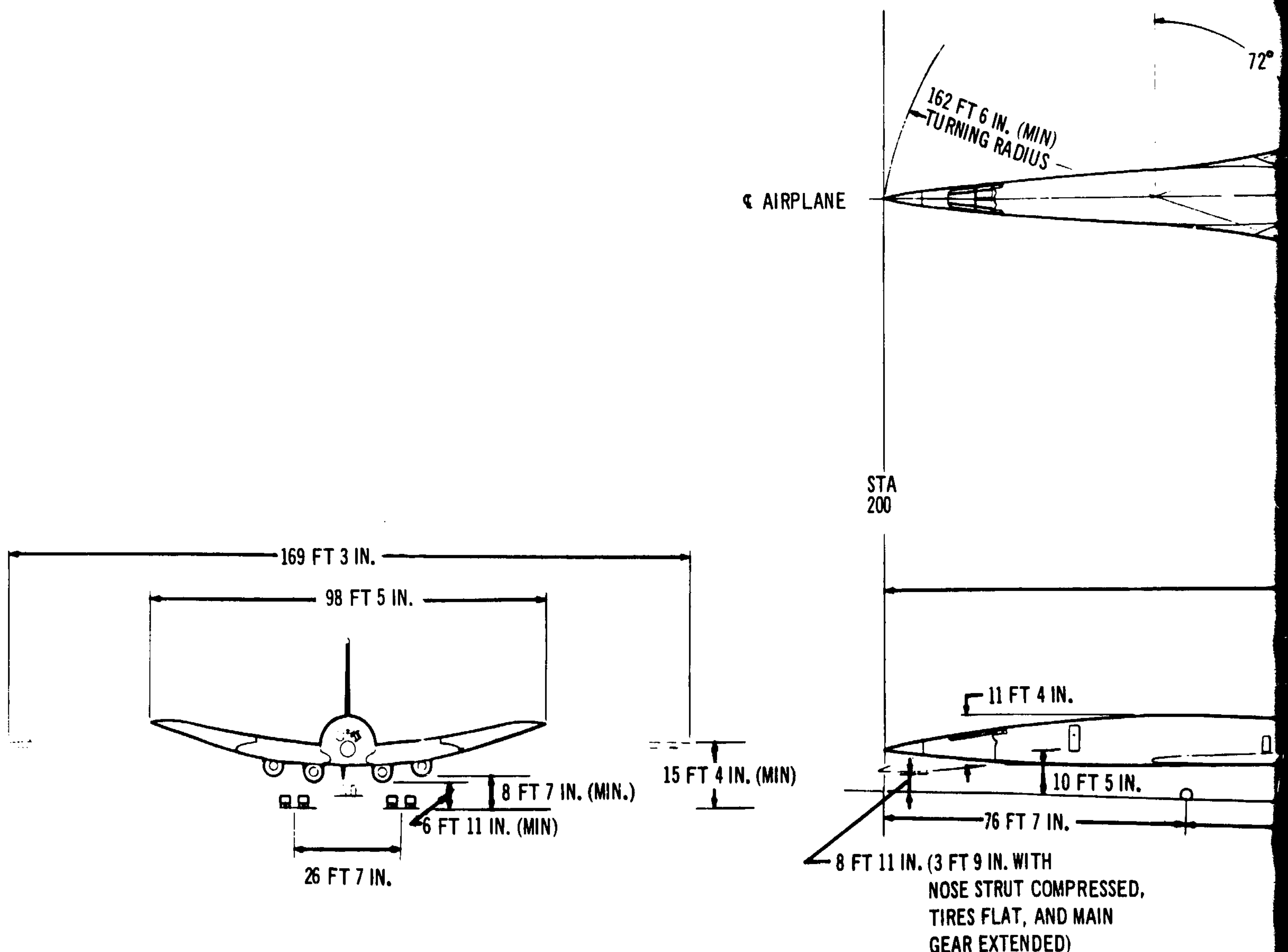
| | |
|---|---|
| **Body Group** | |
| Passenger Cabin Volume, Total | 10,820 cu. ft. |
| Passenger Cabin Floor Area, Total | 1,745 sq. ft. |
| **Wing Group** | |
| Wing Area (Reference-Wings Aft) | 5,019 sq. ft. |
| Aspect Ratio (Wings Aft) | 1.93 |
| Dihedral | 0° |
| Leading Edge Sweep (Wings Forward) | 20° |
| Leading Edge Sweep (Wings Aft) | 72° |
| Mean Aerodynamic Chord (72° sweep) | 718.866 inches |
| Flap Area, Total (including stabilizer flaps and flap-aileron) | 807 sq. ft. |
| **Control Surfaces** | |
| Aileron Area | |
| Inboard | 82 sq. ft. |
| Outboard | 104 sq. ft. |
| Horizontal Tail Area, Total | 841 sq. ft. |
| Vertical Tail Area, Total | 422 sq. ft. |
| Ventral Fin Area | 110 sq. ft. |

## 1.7 ENGINES

Four engines in accordance with the engine manufacturer's specification listed in Par. 2.2.2 shall be installed.

## 1.8 PERFORMANCE

Guaranteed performance data are contained in D6-17850-1 (Section II of this document).


72°
162 FT 6 IN. (MIN)
TURNING RADIUS
℄ AIRPLANE
STA
200
169 FT 3 IN.
98 FT 5 IN.
15 FT 4 IN. (MIN)
8 FT 7 IN. (MIN.)
6 FT 11 IN. (MIN)
26 FT 7 IN.
11 FT 4 IN.
10 FT 5 IN.
76 FT 7 IN.
8 FT 11 IN. (3 FT 9 IN. WITH
NOSE STRUT COMPRESSED,
TIRES FLAT, AND MAIN
GEAR EXTENDED)

A

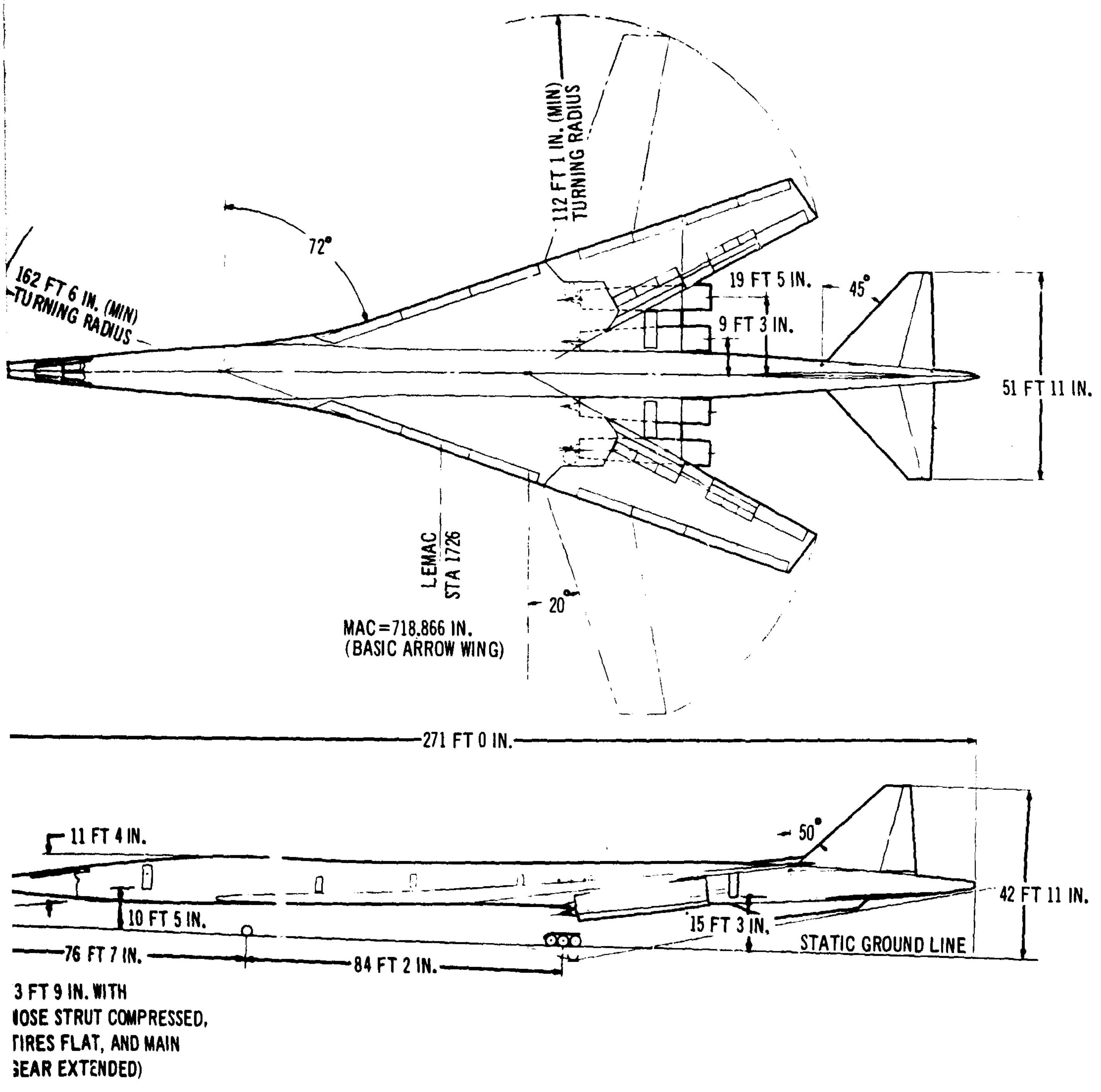
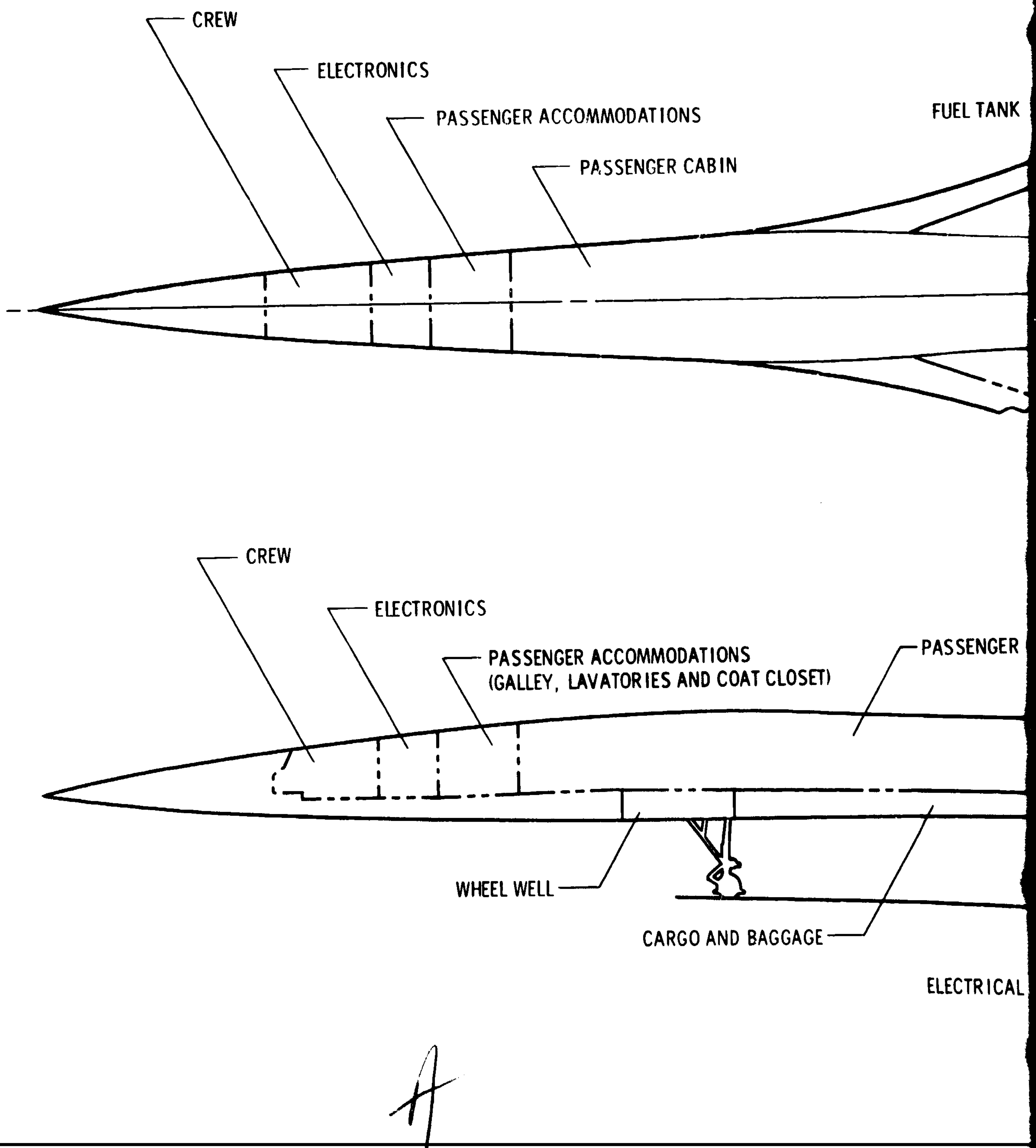
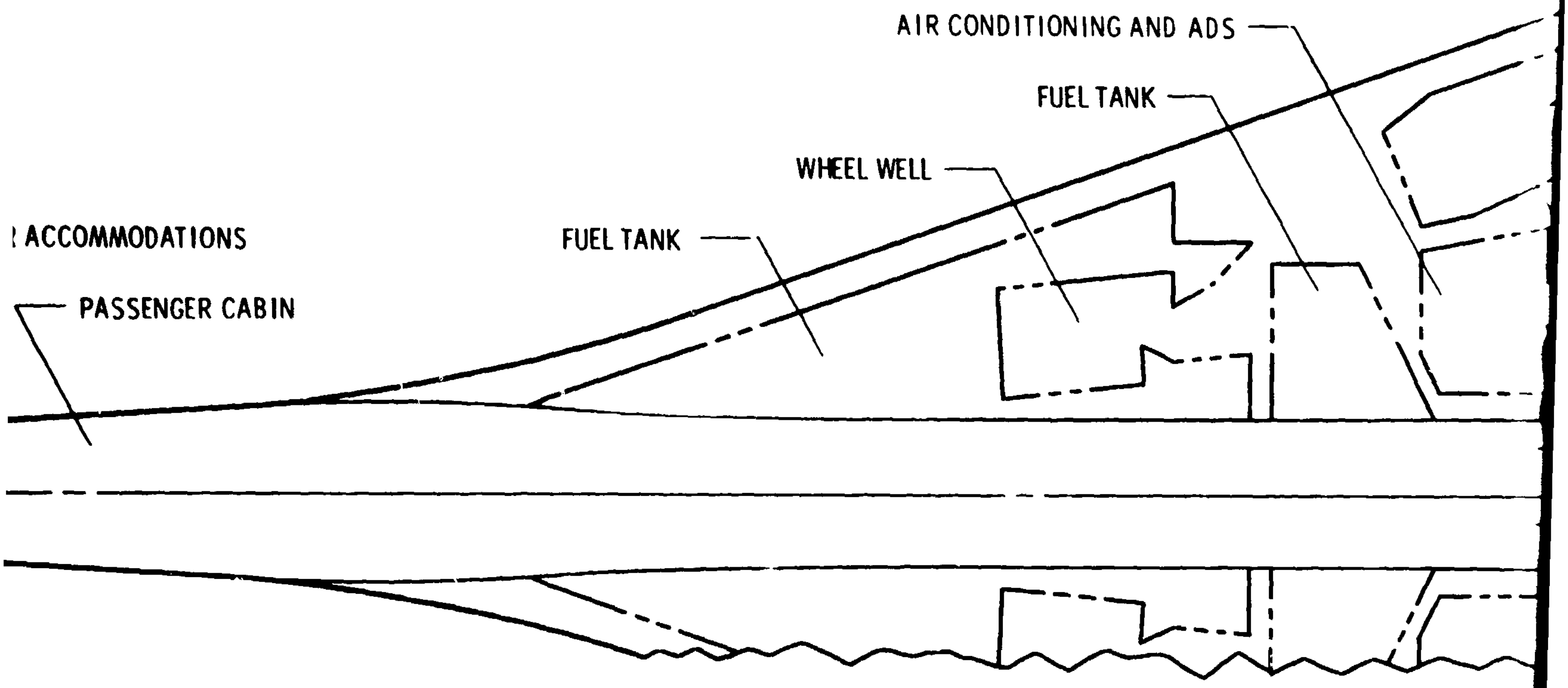



*Fig. 1-1 General Arrangement – Model 733-390*


CREW
ELECTRONICS
PASSENGER ACCOMMODATIONS
PASSENGER CABIN
FUEL TANK
CREW
ELECTRONICS
PASSENGER ACCOMMODATIONS
(GALLEY, LAVATORIES AND COAT CLOSET)
PASSENGER
WHEEL WELL
CARGO AND BAGGAGE
ELECTRICAL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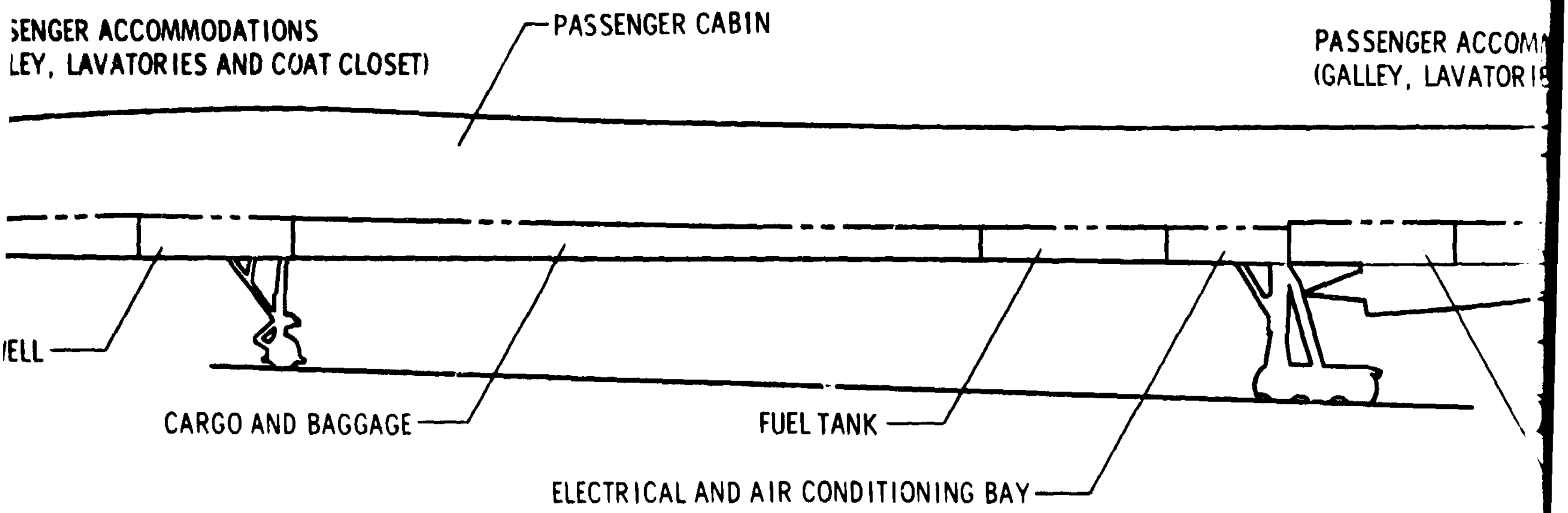
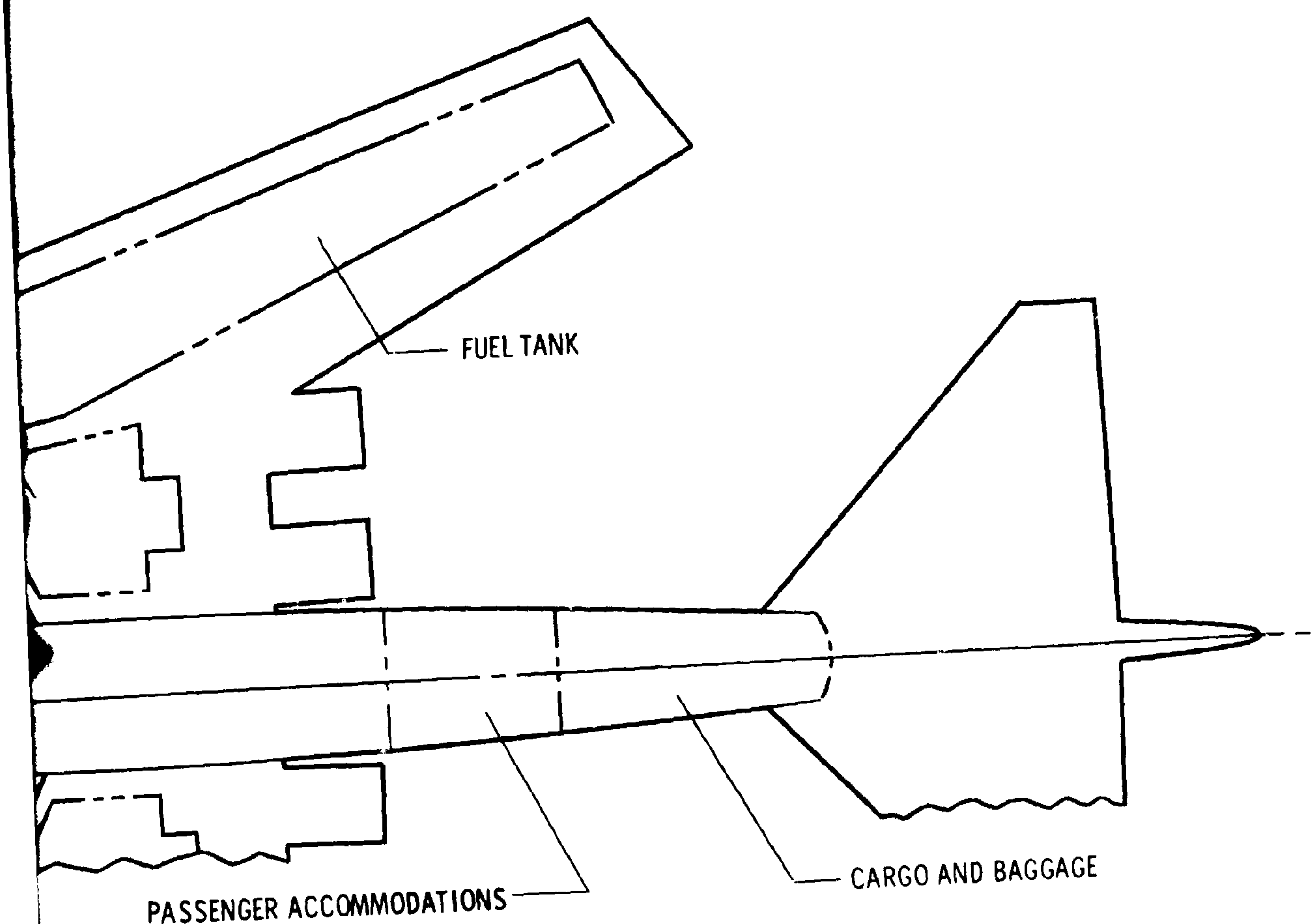
FUEL TANK
WHEEL WELL
ACCOMMODATIONS
FUEL TANK
PASSENGER CABIN


SENGER ACCOMMODATIONS
LEY, LAVATORIES AND COAT CLOSET)
PASSENGER CABIN
PASSENGER ACCOM
(GALLEY, LAVATORI
ELL
CARGO AND BAGGAGE
FUEL TANK
ELECTRICAL AND AIR CONDITIONING BAY

B



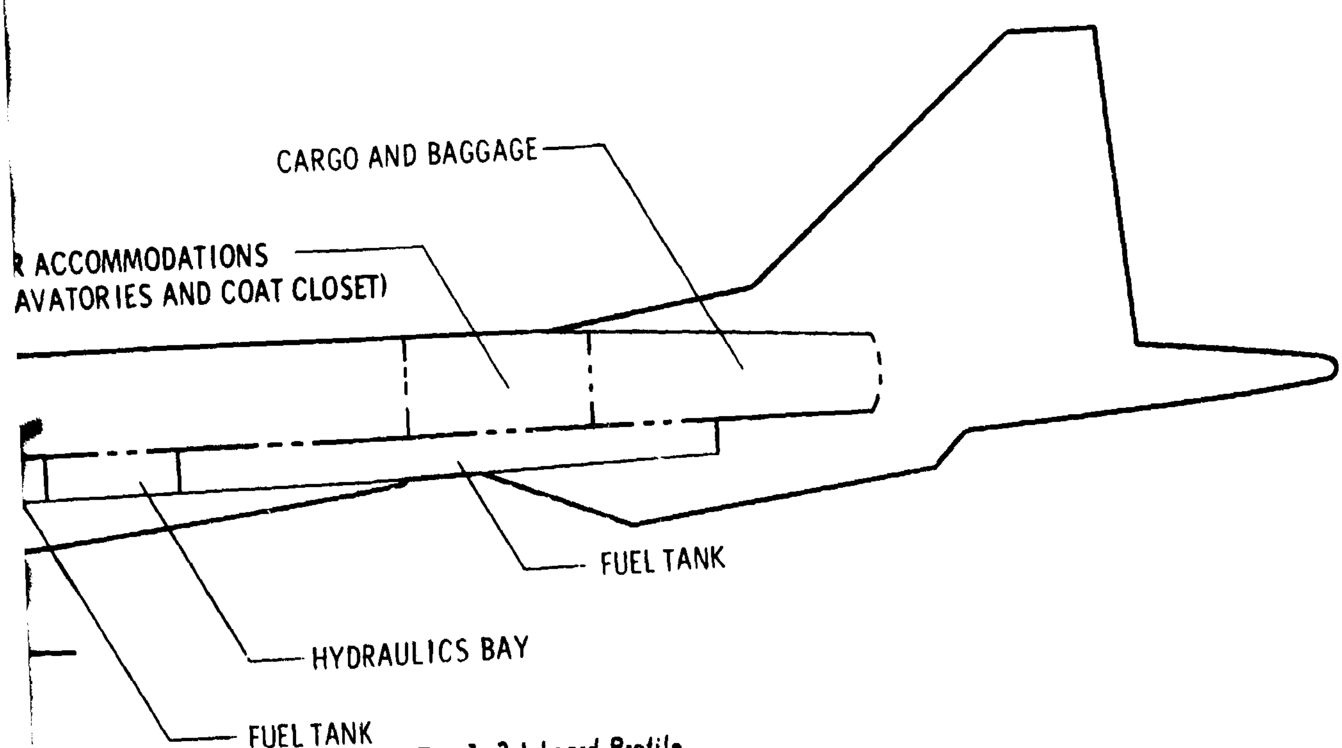




*Fig. 1–2 Inboard Profile*

# 2.0 GENERAL REQUIREMENTS

CONTENTS

# 2.0 GENERAL REQUIREMENTS

2.1 PURCHASE AGREEMENT GOVERNS

In the event of any conflict or discrepancy between this Specification and the Purchase Agreement, the terms in the Purchase Agreement shall govern.

2.2 SPECIFICATION CONTROLLING

2.2.1 Specification Precedence

In the event of any conflict or discrepancy between this Specification and the supplemental specifications listed below, the terms in this Specification shall control.

2.2.2 Supplemental Specifications

- Engine Manufacturer's Specification:
  General Electric Engine Model GE4/J5G, Specification E2040B revised November 1, 1965.
- Electronic Systems and Optional Equipment List
- Electrical Interference Control Requirements, Electrical and Electronic Equipment
- Interior Colors and Materials, D6-6908
- Galley Design and Installation Specification, D6-6954
- Passenger Seat Design Criteria, D6-2556
- Exterior Decorative Markings Specification, D6-6956
- Protective Finishes

## 2.3 CERTIFICATION

### 2.3.1 General

Each airplane shall be certificated in accordance with the terms specified in the Purchase Agreement at weights of not less than the performance or structural limitations specified in Chapters 1.0 and 3.0 of Section I of this Specification.

The airplane shall be certificated for ditching.

### 2.3.2 Dispatch Deviations

FAA-Approved Airplane Flight Manual data shall be provided to define airplane dispatch capabilities under the following conditions:

- With one engine inoperative (nonrevenue ferry flight)
- With antiskid system inoperative

Consideration shall be given, in the airplane design, for the ability to dispatch the airplane on revenue flights with certain other items of equipment inoperative. Further, the Seller shall participate with airline Buyers and FAA in determining a minimum equipment program for dispatch deviation purposes.

## 2.4 DESIGN CHANGES

### 2.4.1 General

Changes in design of the airplane from the configurations described in this Specification shall be defined and handled as follows:

2.4.2 Master Changes

Master Changes are defined as those changes in design selected by the Buyer and agreed to by the Seller that are variations from the standard airplane described in this Specification. The Purchase Agreement and Specification are subject to revision for each Master Change to describe such change and to define the effect of such change on the price, delivery, weight, balance, allowable payload, and performance of the airplane.

2.4.3 Development Changes

Development Changes are defined as those changes from the design specified herein which Boeing reserves the right to make where such changes are deemed necessary to correct defects, make improvements, prevent delay, or ensure compliance with the Purchase Agreement. Any such change shall not adversely affect price, delivery, guaranteed weight, or guaranteed airplane performance. Boeing shall inform the Buyer of such changes on a timely basis.

2.4.4 Changes for Safety or Economics

Boeing also reserves the right to make changes to the design specified herein if such changes are deemed necessary to improve the safety or economics of the airplane. Any such change shall not adversely affect price, guaranteed weight, or guaranteed performance. Boeing shall inform the Buyer of such changes on a timely basis.

2.4.5 Changes Required to Obtain Certification

Changes required to obtain certification are those changes described in the Purchase Agreement under the article entitled "Federal Aviation Agency Approval". Any such change may require revision of the Purchase Agreement and Specification.

2.5 WORKMANSHIP, MATERIALS, AND METHODS

Workmanship, materials, and methods used in the construction of the airplane shall be in accordance with requirements of the FAA and consistent with the state-of-the-art for commercial airplanes of the supersonic transport category at the time the airplane is designed.

2.6 INSPECTION AND TESTS

An accurate and complete system of inspection covering all materials, fabrication methods, and finished parts shall be maintained. Inspection and testing of materials or parts shall be in accordance with procedures established by Boeing and, where appropriate, subject to approval by the FAA.

2.7 PACKING AND MARKING

Each airplane shall be prepared by the Seller for flyaway delivery as set forth in the Purchase Agreement.

2.8 FINISHES, COLORS, AND FABRICS

Exterior and interior finishes shall be as specified in applicable documents listed in Par. 2.2.2. Reasonable deviations from the specified finishes shall be permissible, subject to the provisions of Par. 2.4.

2.9 MOCKUPS

Buyer-requested mockups, additional to those provided for the basic airplane, may be constructed by the Seller when agreed to by Change Order to the Purchase Agreement or by separate written agreement between the Buyer and Seller.

2.10 BUYER-FURNISHED EQUIPMENT

The Purchase Agreement defines the obligations of Buyer and Seller concerning equipment to be furnished by the Buyer for installation in the airplane prior to delivery.

2.11 UNITS OF WEIGHTS AND MEASURES

All airplane manuals, charts, instrument dial markings, placards, nameplates, and maintenance markings shall be in the following units unless stated otherwise in this Specification.

| Dimensions | Units |
|---|---|
| Linear | inches, feet, nautical miles |
| Area | square inches, square feet |
| Volume | cubic inches, cubic feet |
| Liquid Measure | fluid ounces, U. S. gallons |
| Weight | ounces, pounds |
| Speed | knots, Mach number |
| Temperature | degrees Centigrade and/or Fahrenheit |

## 2.12 IDENTIFICATION

### 2.12.1 Seller's Name

The Seller's name and model number shall be displayed on the outside of the airplane so that they can be easily read by boarding passengers. Such display shall be consistent with the Buyer's decorative scheme and shall be approved by the Buyer.

### 2.12.2 Airplane Identification Numbers

The airplanes described by this Specification shall be assigned the following identification numbers:

| Airplane Number | Airplane Tabulation Number | Manufacturer's Serial Number | Registry Number |
|---|---|---|---|
| 1 | * | * | * |

*To be assigned.

## 2.13 CERTIFICATE OF SANITARY CONSTRUCTION

A U. S. Public Health Service certificate of sanitary construction shall be obtained and installed in a location that is visible to passengers, agreed to by the Buyer, and consistent with the interior decorative scheme.

## 2.14 DEFINITIONS

### 2.14.1 Terms and Abbreviations

The terms and abbreviations defined below shall have the meanings specified in this paragraph wherever used in this Specification.

- "FAA" shall mean the United States Federal Aviation Agency.
- "FAR" shall mean the Federal Air Regulations promulgated by the United States Federal Aviation Agency.
- "NASA" shall mean the National Aeronautics and Space Administration.
- "Boeing" or "Seller" shall mean The Boeing Company, and "Buyer" shall mean the purchaser of the airplane(s) described in this Specification.
- "Purchase Agreement" shall mean the contract between Boeing and the Buyer relating to the sale and purchase of the airplane(s) described in this Specification.
- "Standard Day" shall mean U. S. Standard Atmosphere, 1962.
- "ARINC" shall mean Aeronautical Radio, Inc.
- "SAE" shall mean Society of Automotive Engineers.
- "ATA" shall mean Air Transport Association.
- "AIA" shall mean Aerospace Industries Association of America, Inc.
- "ASTM" shall mean American Society for Testing Materials.

2.14.2 Provisions Terminology

The words "provisions for", "structural provisions for", and "space provisions for" shall have the following meanings wherever used in this Specification:

- "Provisions for" a specific item of equipment, or assembly or installation, shall mean that all supports, brackets, tubes and fittings, electrical wiring, hydraulic lines, etc., have been installed and adequate space allocated so that the equipment can be installed without alteration to the specified equipment or the airplane, and that no additional parts are required for installation other than the item itself. Standard stock items such as nuts, bolts, cotter pins, etc., need not be furnished by the Seller.

- "Structural provisions for" a specific installation shall mean that the primary structure will be structurally adequate for the installation but that brackets, bolt holes, electrical wiring, hydraulic lines, etc., will not be provided. Detailed engineering designs of tubing, wiring, parts, and installation will not be made. Attaching structure for a specific item shall be provided only when attaching structure is part of primary structure. The term "primary structure" includes all structural components that are essential to the safety and structural integrity of the airplane. Typical examples of primary structures are: wing spars, ribs, skin, and skin stiffeners; body bulkheads, frames, beams, and skin. The primary structure does not include items such as brackets, angles, channels, fittings, or similar parts that are provided only to attach equipment or accessories to the primary structure.
- "Space provisions for" a specific installation shall mean that the space required for that installation is unoccupied in the airplane. It does not mean that the required space has been allocated or reserved solely for a particular optional installation. Although space may be available for each optional installation individually, the combination of optional installations making up the Buyer's final configuration shall be controlled by the actual space available. "Space provisions for" does not imply that adequate attaching structure is provided; that brackets, bolt holes, electrical wiring, hydraulic lines, etc., will be furnished, designed, or installed; or that the installation itself will be furnished.

## 2.15 STRUCTURAL TERMINOLOGY

The following terms are definitions of the basic strength criteria for design of the aircraft structure:

- "Maximum zero fuel weight" is the maximum gross weight with zero usable fuel.
- "Maximum design flight weight" is the maximum weight for flight as limited by airplane strength and airworthiness requirements. Flaps-up condition will be implied unless otherwise stated.
- "Maximum design landing weight" is the maximum weight at which the airplane shall meet FAR landing requirements.
- "Maximum design taxi weight" is the maximum weight allowed for ground maneuver as specified in applicable FAR criteria. This weight includes the weight of taxi and runup fuel.
- "Allowable payload" is the usable payload at any given time in the airplane life cycle. It is determined by subtracting the operational empty weight from the maximum zero fuel weight.
- "Manufacturer's empty weight" is the weight of the structure, power plant, furnishings, systems, and other items of equipment that are considered an integral part of a particular airplane configuration. It is essentially a "dry" weight, including only those fluids contained in a closed system (such as hydraulic fluid).

# 3.0 GENERAL AIRPLANE CHARACTERISTICS

CONTENTS



ILLUSTRATIONS

# 3.0 GENERAL AIRPLANE CHARACTERISTICS

3.1 GENERAL

The airplane shall be designed to meet the requirements of FAR 25, effective February 1, 1965, and Amendments 1 through 4, or the intent of the requirements of FAR 25 insofar as practicable for this particular design. In addition, the design of the airplane shall be in accordance with the criteria defined in Par. 1.4 and this chapter of the Specification.

3.2 DESIGN STRUCTURAL CRITERIA

3.2.1 Limit Maneuver Load Factors (Flaps Up)

Positive: +2.50g
Negative: -1.00g

3.2.2 Limit Gust Load Criteria

The requirements of FAR 25.341 shall apply, except that, for cruise conditions, the design cruise gust velocity ($V_C$) shall be 60 feet per second at all altitudes between sea level and 20,000 feet, decreasing linearly to 15 feet per second at 80,000 feet. Gust velocities for the design limit diving speed ($V_D$) have been assumed to be constant above 50,000 feet. Gust velocities for the rough air gust penetration speed ($V_B$) have been assumed to be constant above 50,000 feet for subsonic flight and shall not be considered for supersonic flight. For supersonic flight, a supersonic alleviation factor ($K_g$) shall be used in place of the standard subsonic gust alleviation factor.

3.2.3 Limit Speeds

3.2.3.1 Airspeed Designation

The design airspeeds in this Specification are listed as equivalent airspeed (EAS). The placard speeds appearing in the airplane shall be specified in calibrated airspeed (CAS).

3.2.3.2 Design Limit Level Flight Speeds ($V_{MO}/M_{MO}$)

The airplane shall be designed for a maximum operating Mach number ($M_{MO}$) of 2.7 and a maximum stagnation temperature of 500°F (see Fig. 3-1).

3.2.3.3 Design Limit Diving Speed ($V_D/M_D$)

For subsonic flight, $V_D$ shall equal 1.25 $V_{MO}$. For supersonic flight, $M_D$ shall equal Mach 2.9 or a stagnation temperature of 585°F (see Fig. 3-1), which allows for a 7.5-degree nose-down upset with cruise thrust for 20 seconds followed by a 0.5g pullout maneuver.

3.2.3.4 Maximum Gross Weight Maneuver Speed ($V_A$)

See Fig. 3-1.

3.2.3.5 Design Limit Flaps-Down Speeds

The design limit flaps-down speeds shall be a function of wing flap extension and wing sweep positions as follows:

| Outboard Main Flap Extension Position (Reference) | Limit Speeds (Knots EAS) For Wing Sweep Positions of | | | |
|---|---|---|---|---|
| | 20° | 30° | 42° | 72° |
| 5° | 240 | 240 | 250 | 305 |
| 15° | 220 | 220 | 250 | 305 |
| 30° | 195 | 205 | 250 | 305 |

3.2.3.6 Design Landing Gear Operating and Extended Speeds

The design landing gear operating and extended speeds shall be as follows:

| | |
|---|---|
| Retract Speed | 270 knots (EAS) or Mach 0.83 |
| Extend Speed | 270 knots (EAS) or Mach 0.90 |
| Extended Speed (Doors Closed) | 320 knots (EAS) or Mach 0.90 |

3.2.3.7 Speed Brake Extension Speed

The speed brakes shall be operable at all speeds, with deflection limited by air loads.

3.3 DESIGN BALANCE LIMITS

The center-of-gravity limits (percent of MAC with wings in 72-degree sweep position) shall be substantially as shown in Fig. 3-2. Center-of-gravity position for the Operational Empty Weight shall be approximately 51.5-percent MAC with wings in 20-degree sweep position, gear down. ◆

3.4 DESIGN ENVIRONMENTAL CRITERIA

The airplane and all Seller-Furnished Equipment shall function satisfactorily under ground conditions in atmospheric ambient temperatures as follows:

| Pressure Altitude (Feet) | Cold Day | Hot Day |
|---|---|---|
| -1000 to +2500 | -50°F | 120°F* |
| 8000 | -50°F | 101°F* |

*Linear variation of temperature with altitude from 2500 to 8000 feet.

Engine oil, fuel, and hydraulic system temperatures shall be an exception to this requirement (see Pars. 5.5, 5.12.1.1, and 8.1.1).

The airplane and all Seller-Furnished Equipment shall function satisfactorily under flight conditions in atmospheric ambient temperatures defined by Fig. 12-3. Satisfaction of this requirement shall take into account adiabatic temperature rise during flight, solar heating, and the local environment of the installation.

## 3.5 DESIGN NOISE LEVEL CRITERIA

### 3.5.1 Design External Noise Level Criteria

See Section II (D6-17850-1).

### 3.5.2 Design Internal Noise Level Criteria

The overall sound level on the flight deck and in the passenger cabin, measured at head level for aisle seats, shall not exceed the values listed below for a level-flight cruise condition at Mach 2.7, an altitude of 65,000 feet, and a 50-percent passenger load:

| Body Station | Sound Level* (db) |
|---|---|
| Captain's seat | 85 |
| Station 1000 | 85 |
| Station 2500 | 86 |

*Sound pressure levels are in terms of 0.0002 dyne per square centimeter.

The speech interference level (SIL)* shall not exceed 66 db for either supersonic or subsonic cruise at any aisle seat head level position in the passenger cabin. The variation in SIL at head level position between aisle and window seats shall not exceed 3 db.

*Speech interference level is herein defined as the average sound pressure level in the following octave bands: 600-1200, 1200-2400, and 2400-4800 cps.

3.5.3 Design Sonic Boom Overpressure Criteria

See Section II (D6-17850-1).

3.6 APPROACH AND LANDING CAPABILITY

The airplane shall possess characteristics in approach and landing configurations that will enable instrument landing system (ILS) approaches to be conducted by qualified airlines and flight crews to weather minimums of 2600 feet runway visual range (RVR) without assistance from an approach coupler, flight director, or other computing navigation devices.

The airplane shall incorporate computing/display type equipment and/or automatic flight control equipment that will enable qualified airlines and flight crews to satisfactorily complete ILS approaches to touchdown under visibility conditions of 700-foot RVR on airports equipped with adequate approach and runway lighting facilities.

3.7 LANDING CAPABILITY, WINGS AFT

The airplane shall be capable of being landed and brought to a full stop, with the wings fully aft, at a landing weight of 274,000 pounds, with all drag devices which can be extended with wings fully aft, wheel brakes, and two engine thrust reversing system operative, over a 50-foot obstacle, on a wet runway, in 6970 feet or less, in still air, at sea level, on a standard day. The approach speed for this landing condition shall be approximately 206 knots EAS.

3.8 FLIGHT DECK VISIBILITY

Flight deck visibility shall be equivalent to that provided in 707 subsonic jet transports during approach, landing, and takeoff. Further, it shall be an objective to provide flight deck visibility that will meet accepted industry standards for supersonic transports during en route climb, cruise, and descent conditions. It shall be an additional objective to verify that any diminution of flight deck visibility levels, from that of the 707 during climb to altitude and cruise, will not adversely affect safety of flight.

3.9 HANDLING QUALITIES

With stability augmentation functioning normally, airplane handling qualities shall be equal to or better than those of 707 subsonic jet transports.

3.10 ESTIMATED WEIGHTS (POUNDS)

| | | | |
|---|---|---|---|
| Manufacturer's Empty Weight | | | 222,870 |
| Standard Items: | | | 1,975 |
| Unusable Fuel | | 705 | |
| Unusable Oil - Hydraulics and Lubrication | | 250 | |
| Emergency Equipment | | 260 | |
| Oxygen Equipment (Portable) | 44 | | |
| Crash Axes (2) | 6 | | |
| Escape Slides (6) | 210 | | |
| Unusable Water - Washing and Drinking | | 10 | |
| Toilet Water and Chemical | | 150 | |
| Galley Structure (3) | | 600 | |
| Basic Empty Weight | | | 224,845 |
| Operational Items: | | | 4,655 |
| Crew and Crew Baggage | | 1,385 | |
| Flight Crew (3) | 510 | | |
| Cabin Attendants (5) | 650 | | |
| Crew Baggage (8) | 200 | | |
| Captain's Briefcase (1) | 25 | | |
| Usable Oil - Lubrication | | 60 | |
| Emergency Equipment | | 1,500 | |
| 25-Man Life Rafts (9) | 1,125 | | |
| Automatic Emergency Beacon (9) | 45 | | |
| Life Vests (220) | 330 | | |
| Usable Water - Washing and Drinking | | 316 | |
| Passenger Service Equipment (200 Persons) | | 520 | |
| Food and Beverage (208 Persons, Including Crew) | | 250 | |
| Galley Service (208 Persons, Including Crew) | | 624 | |
| OPERATIONAL EMPTY WEIGHT | | | 229,500 |

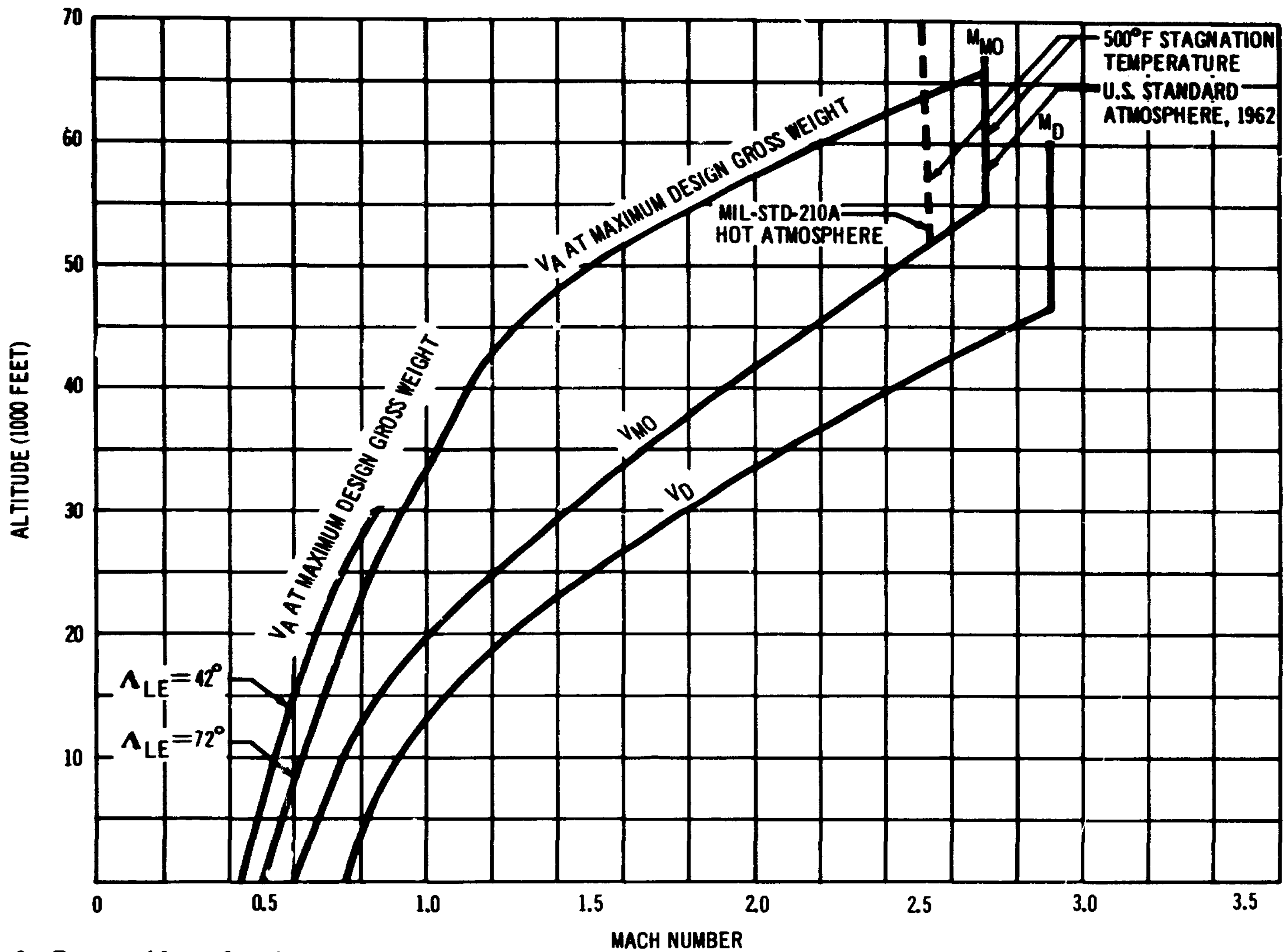



*Fig. 3-1 Estimated Limit Speeds*

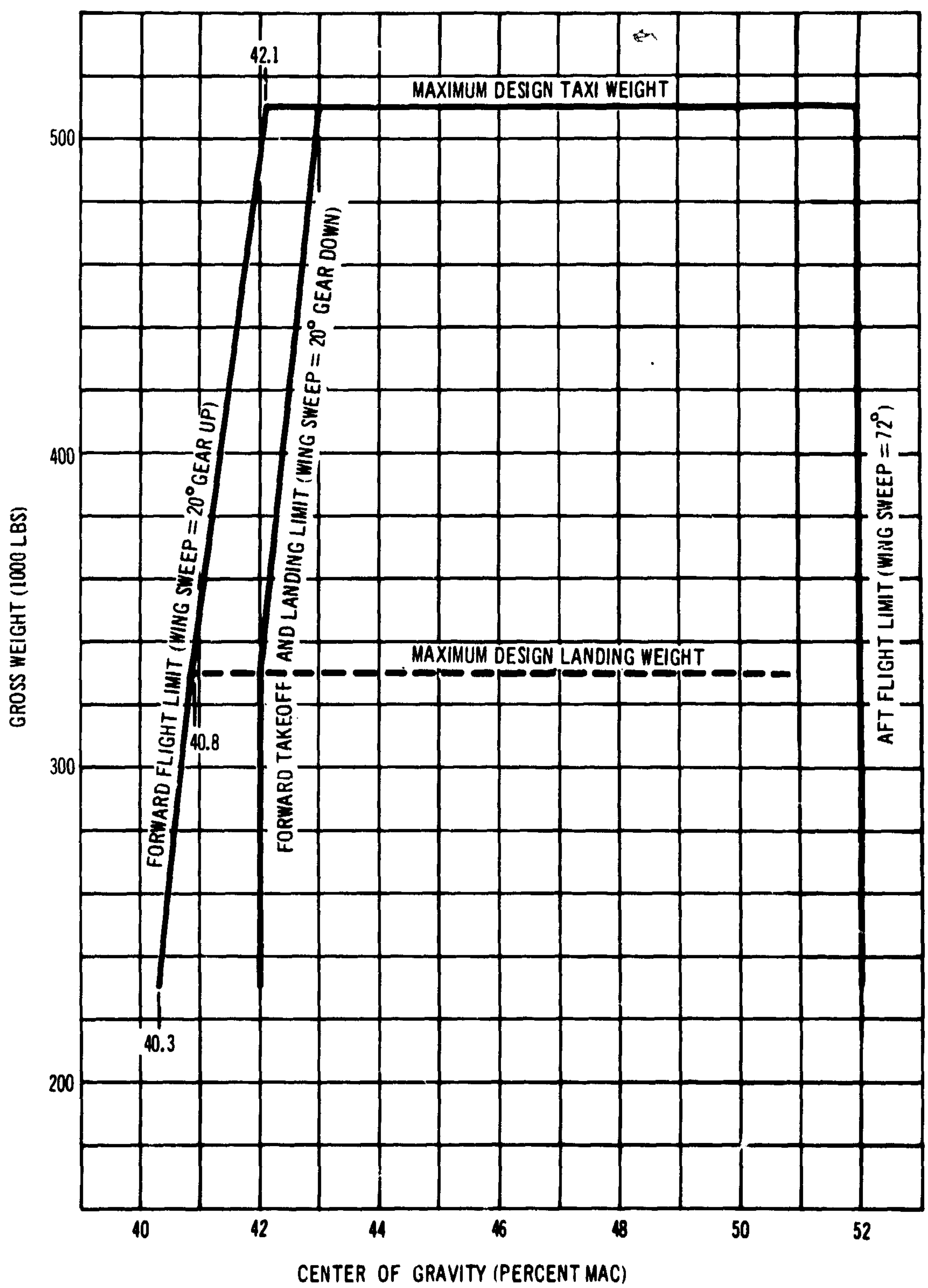



*Fig. 3-2 Center-of-Gravity Limits*

J6-17850

# 4.0 AIRFRAME STRUCTURES

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CONTENTS (Continued)

# 4.0 AIRFRAME STRUCTURES

4.1 GENERAL

4.1.1 Service Life

A service life of not less than 50,000 flight hours shall be the criteria to which the primary structure of the airplane is designed. The structural life shall be verified by analyses and by results of structural tests.

4.1.2 Materials

The structure, in general, shall be fabricated of titanium alloy. Panel assemblies made of titanium and/or fiberglass faces bonded to fiberglass or titanium honeycomb shall be used in selected applications. Limited use shall be made of alloy steels, heat treated to high strength levels. Other steels and aluminum alloys may be used as dictated by design requirements.

4.1.3 Fabrication

Conventional methods of manufacture shall be used, including roll, brake, and stretch forming; machining; and chem-milling. Fusion welding, spotwelding, bonding, and mechanical fasteners shall be used to assemble primary and secondary structure.

4.1.4 Drainage and Ventilation

Provisions shall be made for drainage at points where any fluids may be expected to collect. These provisions shall permit rapid drainage of flushing agents that may be used to remove flammable fluids in areas where fuel lines are installed. Removal of access panels shall be acceptable for

providing entry into such areas for flushing. (For propulsion pod drainage description, see Par. 5.3.)

Means shall also be provided to prevent entry of ceiling condensation into the passenger cabin interior.

Ventilation shall be provided to prevent accumulation of hazardous vapors. Galley areas and lavatory compartments shall be adequately vented (see Par. 12.2.1).

4.1.5 Protective Finish

Corrosion protection shall be provided for all structure either by choice of corrosion resistant materials or by use of protective finishes. Special attention shall be given to providing protection against corrosion where dissimilar materials and metals are employed.

4.1.6 Smoothness

Structural smoothness criteria, as determined by the Seller, shall be compatible with airplane speed characteristics.

4.1.7 Jacking

Three main jack points and five stabilizing points shall be provided. Means for jacking shall also be provided on the main and nose landing gear.

The main jacking points shall be designed for an ultimate load factor of 2.5 based on an airplane weight of 300,000 pounds. The axle jacking points shall be designed for jacking the airplane at the design taxi gross weight and shall permit changing four flat tires on the same axle.

4.1.8 Towing

Lugs, suitable for towing forward or pushing backward, shall be provided on the main and nose gears. Towing shall be possible within the 74-degree steering angle without disconnecting the torsion links. The nose gear may be swivelled through 360 degrees by disconnecting the torsion links.

The design ultimate towing or pushing loads shall be 115,000 pounds for the nose gear and 87,000 pounds for each main landing gear. The design of the nose gear shall permit towing the airplane at the maximum design taxi weight on hard, smooth surfaces of less than 3-percent grade.

4.1.9 Hoisting

Provisions shall be incorporated to facilitate hoisting and handling major assemblies and components such as the movable wing sections, stabilizers, fin and tail cone, trailing edge flaps, rudders, and nose cone. Suitable provisions shall be incorporated on the lower surface of the fixed wing to permit attachment of engine hoisting equipment.

4.1.10 Wheels-Up Landing

The airplane structure shall be designed to minimize damage to primary structure and to minimize the hazards of fire and fuel tank rupture in the event of a wheels-up landing.

4.2 WING

4.2.1 General Description

The wing shall be composed of five major sections: one main center section extending from the wing pivot on the left to

the pivot on the right, two fixed sections forward of the main center section, and two movable wing sections extending outboard from the pivots.

4.2.2 Basic Structure

Primary wing structure shall be fabricated from titanium alloy tapered skin, stiffened with extruded and formed section titanium alloy stringers. The two spars shall serve primarily as shear carrying members; the skin and stringers shall carry the major portion of wing bending loads. Spars shall be built of extruded upper and lower chords and a tapered web. The wing box structure of the center section, movable wings, and the two fixed sections forward of the main center section shall be designed to contain fuel. The center section shall also be designed to support the propulsion pods and the main landing gear. Access to the wing box for fabrication, inspection, and repair shall be provided.

The primary structure of the wing pivot shall be of laminated, segmented construction to provide multipath fail-safe characteristics consistent with those of the inner and outer wing structure.

The pivots shall incorporate large diameter bearing assemblies using nonmetallic bearing surfaces that require no lubrication. It shall be possible to inspect and/or replace the bearing assemblies without removing the outer wing panels. Dust seals shall be provided to exclude foreign matter from the pivot bearings.

4.2.2.1 Leading Edge

The fixed portion of the leading edge shall consist of ribs, skin, and honeycomb panel assemblies. Access shall be provided through nonstructural panels in the lower surface.

4.2.2.2 Trailing Edge

The fixed portion of the wing trailing edge shall be constructed of ribs, skins, and honeycomb panel assemblies. Access shall be provided to all trailing edge device actuators and other service points. If access panels are required they shall be of the nonstructural type.

4.2.3 Leading Edge Devices and Trailing Edge Flaps

The movable leading edge high lift devices shall be of honeycomb and built-up construction. Slotted trailing edge flap sections shall be provided and shall be of honeycomb and built-up construction.

4.2.4 Spoilers

Spoilers hinged near the rear spar shall be installed on the wing upper surface. They shall be of honeycomb and built-up construction.

4.2.5 Ailerons

Ailerons shall be provided on the left and right movable outboard wings. Ailerons shall be constructed of ribs, skins, and honeycomb panel assemblies.

4.3 TAIL

A vertical tail consisting of a vertical fin, rudder, and ventral fin and a horizontal tail consisting of a horizontal stabilizer with a movable trailing edge shall be provided.

4.3.1 Vertical Fin

The vertical fin shall consist of multiple spars, ribs, and cover panels.

4.3.2 Rudder

The rudder shall be mounted on hinges attached to the rear spar of the vertical fin. Construction shall consist of ribs and spars with cover panels.

4.3.3 Ventral Fin

The ventral fin shall be constructed of ribs with cover panels. Attachment to the body shall be by mechanical means.

4.3.4 Horizontal Stabilizer

The all-movable stabilizer shall consist of multiple spars, stringers, ribs, and cover panels.

4.3.5 Stabilizer Trailing Edge

The stabilizer movable trailing edge shall be constructed of spars and ribs with cover panels.

## 4.4 BODY

### 4.4.1 General Description

The body shall be composed of five sections: the forward section, composed of the nose, the flight deck, and the electronics compartment; the forward section of the passenger compartment; the center section of the passenger compartment; the aft section of the passenger compartment; and a tail section, including the aft cargo compartment and tail cone. The central body section shall enclose the wing center section. Dimensions of the body shall be substantially as shown in Fig. 1-1.

The body shall be of semimonocoque construction, consisting of frames and skins stiffened with longitudinal stringers. Honeycomb panels may be used in certain areas. The nose section shall be of variable geometry, faired for maximum supersonic efficiency, and rotated down for improved subsonic flight crew visibility (see Par. 9.16). The nose shall include a radome (see Par. 10.2.2). The movable nose section shall have provisions to prevent damage or faulty operation due to accumulation of water, slush, ice, or dirt during flight, takeoff, landing, taxiing or when parked. ◊

The body shall be sealed to contain air pressure within the boundaries shown on Fig. 12-2. Normal maximum differential operating pressure shall be 11.12 psi. Decompression panels or other means of pressure relief shall be provided between pressurized compartments in the body.

Titanium alloy bulkheads, at approximately 60-inch spacing, and nonmetallic backing boards shall be provided to support the fuel cells in the body lower lobe. A titanium alloy ◊

barrier shall be provided between the body fuel tanks and the passenger cabin floor.

4.4.2 Interior Arrangement

4.4.2.1 Passenger Cabin

The interior arrangement of the passenger cabin shall be substantially as shown in Fig. 11-1. See Chapter 11.0 for description of passenger and cargo accommodations.

4.4.2.2 Flight Deck

The arrangement of the flight deck shall be substantially as shown in Fig. 6-1. See Chapter 6.0 for description of flight crew accommodations.

4.4.2.3 Cargo Compartments

The compartments shall be designed to accommodate cargo having an average density of 10 pounds per cubic foot. The lower and upper cargo compartments shall be designed for a maximum weight capacity of 5370 pounds and 7180 pounds respectively. (See Figs. 11-4 and 11-5.)

Access to the cargo compartments shall be provided from inside the passenger cabin without the necessity of removing fixed equipment such as galleys and toilets, in the event of internal blocking of the cargo doors.

### 4.4.3 FLOORING

#### 4.4.3.1 General

The passenger cabin floor, upper cargo compartment floor, and a portion of the flight deck floor shall be readily removable by means of screw attachments. The passenger cabin floor shall be resistant to impact of high heeled shoes. The underside of the flight deck floor shall be accessible from the compartment below the flight deck (accessible from outside the airplane) and through access panels in the flight deck floor.

Floor panels shall be readily removable without the need for removing fixed partitions and galley sections (except panels directly under galley sections). Floor panels having sealed joints may require breaking and reinstalling seals. ◆

A minimum number of different floor panel configurations shall be provided. Whenever possible, floor panels shall be interchangeable within the airplane and between airplanes. ◆

#### 4.4.3.2 Passenger Cabin Floor

The passenger cabin floor arrangement shall provide for track-mounted passenger seats. The tracks, flush with the floor and replaceable, shall provide for fore and aft seat location adjustment in increments of 1 inch, except in the galley and entry door areas.

#### 4.4.3.3 Passenger Cabin Floor Loading

The passenger cabin floor and supporting structure shall be designed for the following loads:

- Seat loads consisting of passengers and seats with a static weight not exceeding 200 pounds per seat to the ultimate load factors specified in Par. 11.2.3 and based on four, five, and six abreast seating as applicable at 32-inch seat spacing.
- Cargo load of 100 pounds per square foot, uniformly distributed, but not more than 38 pounds per inch of compartment length.

The floors in the heavy traffic areas shall be capable of withstanding a concentrated load of 300 pounds applied with a 3/4-inch-diameter steel ball at any point on the top surface, without failure or permanent indentation greater than 0.050 inch. The remainder of the floors shall be capable of withstanding a concentrated load of 200 pounds applied in a similar manner without failure or permanent indentation greater than 0.050 inch. ◊

4.4.3.4 Cargo Compartment Floor Loading

The cargo compartment floors shall be designed for uniformly distributed loading of 150 pounds per square foot, but not more than 50 pounds per inch of compartment length. (See Par. 4.4.2.3 for compartment weight capacities.)

All cargo compartment flooring shall be capable of withstanding a concentrated load of 400 pounds applied with a 3/4-inch-diameter steel ball at any point on the top surface, without failure or permanent indentation greater than 0.050 inch. ◊

4.4.3.5 Protection

Structural components in the vicinity of the lavatory compartments, storage battery compartments, and main entryways shall be protected as required against corrosive action of liquids that may accidentally come in contact with them.

The floor in the lavatory, galley, and main entry areas shall be sealed to prevent seepage through joints. Other joints in the passenger cabin floor shall be designed to minimize seepage, and the floor material shall be resistant to absorption of water.

4.4.4 Windows

The arrangement of windows shall be substantially as shown in Fig. 1-1.

4.4.4.1 Passenger Cabin

Passenger cabin windows, including windows in the emergency exits, shall be approximately 6.5 inches in diameter, at approximately 40-inch spacing. The windows shall be interchangeable and shall consist of dual pressure panes and an inner cover panel.

4.4.4.2 Flight Deck

Two forward windshields and the four side windows shall be provided in the flight deck area. Each side window shall consist of an outer pane, an intermediate pane, and an inner pane, with air spaces between panes. The inner pane of each windshield shall be of laminated construction. (See Par. 12.7.5 for anti-icing and anti-fogging provisions.)

Windows shall be provided in the movable nose section.

4.4.4.3 Observation Windows

Wide-angle lenses shall be installed in each main entry and galley service door. Pan-type recesses with sufficient bevel to allow wide-angle vision shall be provided.

Wide-angle lenses shall be installed in the doors between the electronics compartment and flight deck, the electronics compartment and passenger cabin, and the aft cargo compartment and the passenger cabin. Wide-angle lenses shall be provided in the floor to permit inflight viewing of the lower cargo compartment.

## 4.4.5 Doors and Hatches

### 4.4.5.1 General

The external doors and emergency exits shall be arranged substantially as shown in Figs. 6-1 and 11-1. External doors (except maintenance access doors) and emergency exits shall be operable from both inside and outside the airplane. Stops and catches shall be provided to hold outward-opening doors in the open position.

The hold-open latches on the main entry doors and galley service doors shall be designed for a 75-mph gust at 1.5 factors ultimate. The main entry and galley service doors and door hold-open latches shall be operable from either inside or outside the airplane.

### 4.4.5.2 Main Entry Doors

One forward and one aft plug-type entry door, each approximately 30 inches wide and 72 inches high shall be provided. The doors shall be located on the left side of the airplane.

### 4.4.5.3 Galley Service Doors

One forward and one aft plug-type galley service door, each approximately 30 inches wide and 60 inches high shall be provided. The doors shall be located on the right side of the airplane.

4.4.5.4 Cargo Doors

One translating, sliding, plug-type door, approximately 42 inches wide and 48 inches high, shall be provided for the upper cargo compartment. The door shall be located on the right side of the airplane.

Three translating, sliding, plug-type doors, two approximately 36 inches long and 30 inches wide, and one approximately 36 inches long and 48 inches wide shall be provided for the lower cargo compartment. The doors shall be located on the bottom of the body.

Cargo compartment doors shall be operable from inside and outside the airplane. Means shall be provided to gain external access to the cargo door latch mechanisms to be able to open the doors in the event of failure of the operating mechanism. ◊

4.4.5.5 Emergency Exits

Eight plug-type emergency exits (six approximately 20 inches wide and 38 inches high, and two approximately 20 inches wide by 44 inches high), inward opening, and capable of being opened from inside or outside the airplane, shall be provided in the passenger cabin area. The exits shall be located (four each side of the body) over the wing or strake and shall be separated to aid egress. Emergency exit location shall be determined with due consideration to flexibility of interior arrangement.

Two plug-type emergency exits shall be provided in the flight deck. (See Fig. 6-1.) The left hand exit shall be hinged to permit its use for ground communication and ventilation. Both exits shall be operable from inside or outside of the airplane.

4.4.5.6 Equipment Access Doors in Lower Body Sections

Seven plug-type doors (four approximately 18 by 18 inches, and three approximately 18 by 30 inches) shall provide access to equipment installed in the lower forward body sections through the bottom of the body. Four plug-type doors (two approximately 19 by 20 inches and two approximately 19 by 30 inches) shall provide access to equipment installed in the lower aft body sections through the bottom of the body. All access doors shall be operable from outside the airplane. The door handle position shall positively indicate from the exterior whether the door is securely latched or open.

4.4.5.7 Seals

All door seals shall be designed and located to minimize damage from normal service and maintenance. The seals shall be attached by mechanical means to facilitate replacement.

4.4.5.8 Scuff Plates

Replaceable, wear-resistant scuff plates shall be provided at entry, galley, and cargo doors.

4.4.5.9 Lock Indicators

Indicators located in the flight deck area shall be provided to warn when any of the following doors are not closed and locked: main entry doors, galley service doors, external cargo doors, landing gear doors, and lower body equipment access doors. The light switches for the above-mentioned doors shall be readily accessible.

4.5 LANDING GEAR

The landing gear shall be retracted and extended hydraulically. (See Par. 8.1.17 for details of operation.) Principal dimensions of the landing gear shall be as shown in Fig. 1-1. Means for emergency extension of the nose and main gears shall be provided. The landing gear shall be designed to minimize aircraft difficulties relating to "chatter", "spring back" and other dynamic considerations which can produce either discomfort or unacceptable stress levels. Major components of the main, nose and tail landing gears shall be fabricated from heat treated steel forgings, aluminum alloys, and/or titanium alloys. Pin joints in the landing gear structure and retracting mechanism shall be equipped with replaceable bushings or bearings. Means shall be provided, where necessary, to permit periodic lubrication of moving joints. All lugs shall have adequate wall thickness to allow oversizing of holes. Deflectors shall be provided on the landing gear to minimize engine ingestion of foreign material.

4.5.1 Main Gear

Each main gear shall consist of a six wheel, twelve tire truck, an oleo, and a hydraulic actuation system. The main gear shall retract forward. Provisions shall be made for jacking and towing (see Pars. 4.1.7 and 4.1.8). A grounding lug shall be provided on the right main gear.

Equalizing linkages shall be provided to distribute the load between the wheels on the front, center, and rear axles of each truck to reduce truck pitching during braking.

Fusible plugs shall be provided on all wheels. Replaceable sleeves shall be used on the axles in the areas of the brake carriers.

4.5.2 **Nose Gear**

The nose gear shall consist of an axle with two wheels and two tires, an oleo, and a hydraulic actuation system. The nose gear shall retract forward. Towing and jacking lugs shall be protected against possible tow bar damage arising from normal operational procedures.

4.5.3 **Tail Gear**

The tail gear shall consist of an axle with two wheels and two tires, an oleo, and a hydraulic actuation system. The tail gear shall be retractable.

4.5.4 **Wheels, Brakes, and Tires**

Wheels, brakes, and tubeless tires shall be as listed in Appendix I.A. Brakes shall be equipped with heat shields and ground cooling fans. (See Par. 8.1.19 for operation and control of the brake and antiskid system.)

4.5.5 **Steering**

Nose gear steering shall be provided in accordance with requirements of Par. 8.1.18. Maximum steering angle shall be approximately 74 degrees to either side of center.

4.5.6 **Ground Locks**

Provisions shall be made for ground locks on the main and nose landing gears. The landing gear installation shall not be damaged if the gear actuation system is pressurized with the ground locks in place and the airplane on jacks.

4.5.7 Landing Gear Up- and Down-Locks

Positive engaging up- and down-locks shall be provided. The up-locks shall be designed to retain the landing gear in the retracted position under all flight conditions without hydraulic pressure. The down-lock shall be capable of holding the landing gear in the down position during all routine conditions of landing, taxiing, and ground handling without hydraulic pressure.

4.5.8 Landing Gear Up- and Down-Lock Indication

Means shall be provided to indicate when the main, nose, and tail gears are up and locked. Means shall be provided to indicate visually when the main and nose gears are down and locked.

# 5.0 PROPULSION

CONTENTS

CONTENTS (Continued)



ILLUSTRATIONS

# 5.0 PROPULSION

5.1 GENERAL

5.1.1 Description

The propulsion system shall consist of four separate propulsion pods each including an inlet, engine and engine accessories, exhaust system, and associated cowling. The airplane fuel system and accessory drive system are also described in this section because of their interrelationship with the propulsion system. The propulsion and fuel systems shall be designed for use with commercial aviation kerosene meeting the minimum requirements of ASTM D1655-63T Jet A or A-1.

5.1.2 Maintainability

During design, special attention shall be given to the ease with which components can be inspected, maintained, and repaired. Engine accessories and equipment will be readily replaceable. The inlet and exhaust systems will be designed to permit their removal or installation without removing the engines from the airplane.

5.1.3 Interchangeability

It shall be a design objective that common parts and assemblies subject to removal from the engine for routine maintenance be made interchangeable or replaceable-interchangeable. Each propulsion pod shall be interchangeable between pod positions and airplanes.

## 5.2 PROPULSION PODS

### 5.2.1 Materials and Construction

The propulsion pods shall be constructed principally of titanium alloy and stainless steel. It shall be a design objective to utilize materials which minimize the hazards that could result from a wheels-up landing.

### 5.2.2 Mounting

Each propulsion pod shall be attached to the fixed wing lower surface. Support fittings shall be designed to allow for thermal expansion of the engines.

The engine mounting attach points shall be designed to retain the engine in the event of sudden engine stoppage at a uniform deceleration from takeoff rpm to zero rotational speed in 1.0 second.

It will be a design objective to attach the pods and mount the engine accessories, fuel lines, etc., to limit the damage and minimize the hazards that could result from a wheels-up landing.

### 5.2.3 Inlet

The inlet shall be axisymmetrical, incorporating a variable diameter centerbody to control inlet throat area and doors to bypass excess air and control the normal shock (see Fig. 5-1). The inlet system shall be supported from the engine. Automatic control, using an individual inlet mounted, self-contained, engine driven hydraulic system with two pumps, shall be provided for positive inlet operation,

including starting the shock system, restarting the shock system, excess air control, compressor noise reduction, and maintaining high inlet performance through all operating regimes. Means shall be provided to allow for small incremental trim control of bypass air.

Instrumentation shall be provided on the flight engineer's panel to monitor automatic control system operation. Controls shall be installed to permit optional manual control of the inlet system.

Operation of the landing gear under any flight condition within the landing gear speed envelope defined in Par. 3.2.3.6 shall not significantly affect the engine and inlet performance or require special operating techniques for the engine or inlet. ◊

The inlet shall be designed to minimize ingestion of foreign material into the engine. It shall be a design objective to select fasteners, clips, etc., provided with means to preclude their ingestion into the engine. For protection from externally generated foreign material, refer to Par. 4.5. ◊

### 5.2.4 Cowling

Cowling enclosing the engine section shall extend from the aft outer surface of the inlet assembly to the exhaust system. The cowling for each engine shall be divided longitudinally into three panels. Quick release latches shall be provided to facilitate opening and removal of the panels. An access panel shall be provided in each cowling for engine oil system servicing. Panels shall be incorporated in the cowling of each propulsion pod for ground fire extinguishing equipment access. Provisions for controlling

inflight engine fire by burn-through shall be included in the cowling design. Engine fuel and oil system filters requiring frequent inspection shall be accessible without removal of cowl panels or opening of more than one cowl panel.

5.2.5 Exhaust System

The exhaust system (see Fig. 5-2) will be supported from the engine. It will consist of a variable area convergent-divergent ejector nozzle, an integrated thrust reverser, actuators, controls, and associated plumbing.

## 5.3 PROPULSION POD DRAINAGE

A propulsion pod drainage system shall be provided.

## 5.4 ENGINE THRUST CONTROLS

Forward and reverse thrust of each engine shall be controlled by a thrust lever, located on the pilots' control stand, which shall actuate a cable system and linkage to the respective engine. A device shall be provided to prevent thrust control lever creep.

Means shall be provided to prevent inadvertent actuation of the thrust reverser in the air. The flight crew shall be provided with an indication whenever a reverser is in other than the forward thrust (stowed) position.

Means shall be provided to limit thrust lever travel in the event that the reverser is not in the desired position.

## 5.5 ENGINE LUBRICATION SYSTEM

The engine lubricating system, including filters, oil tank, and engine oil/fuel heat exchanger, will be an integral part of the engine and will be suitable for use with a lubricant approved by the engine manufacturer. The oil tank mounted on each engine will have means for determining oil level and will have provisions for both pressure and gravity filling. The oil temperature will be automatically maintained within required limits for each engine through use of an engine oil/fuel heat exchanger. The lubrication system will operate satisfactorily with the oil at a temperature of -40°F without preheating and/or dilution of oil.

## 5.6 ENGINE ACCESSORIES

The following engine accessories will be mounted on each engine:

- Fuel control
- Fuel pumps
- Engine oil/fuel heat exchanger
- Hydraulic oil/fuel heat exchangers (including engine exhaust system and inlet hydraulic oil coolers)
- Oil tank and pumps
- Hydraulic pumps (for exhaust system control)
- Tachometer generator
- Ignition units
- Vibration pickups

## 5.7 ENGINE STARTING SYSTEM

Four identical pneumatic starters, one for each engine, shall be installed (see Par. 5.11). Any engine may be started by using low pressure air from a ground supply. After one

engine has been started it shall be possible to start the remaining engines using air from the operating engine.

The engine start switches and levers, separate from the thrust controls, shall be located on the control stand.

5.8 WINDMILLING BRAKE

An integral engine windmilling brake, controlled by the engine start lever, will be provided.

5.9 FIRE PROTECTION

5.9.1 Firewall

Titanium alloy and/or stainless steel firewalls shall be provided to isolate each propulsion pod from the wing. Material used for the upper portions of the engine cowling shall effectively serve as a fire barrier to protect the wing lower surface.

5.9.2 Electrical Wiring

Electrical wiring shall be isolated from, or installed above, fluid carrying lines. All fluid carrying lines and electrical leads shall enter the engine compartment through fireproof fittings. The holes for lines passing through any intermediate bulkhead shall be draft sealed.

5.9.3 Engine Fire Detector System

A quick acting fire detector system shall be installed for each engine (see Par. 9.14.4).

5.9.4 Fire Extinguishing System

A fire extinguishing system shall be installed to supply bromotrifluoromethane fire extinguishing agent to each propulsion pod and to each equipment bay fire zone, (see Par. 12.2.6). Two extinguisher bottles shall be installed on each side of the airplane. The system shall be designed to permit either or both bottles to be discharged into either propulsion pod engine compartment or either equipment bay fire zone as selected by the pilots.

5.9.5 Fire Shutoff Control

A fire switch, located on the pilots' overhead panel shall be provided for each engine. This switch shall shut off systems in accordance with Par. 9.15.1.

5.10 INSTRUMENTATION

5.10.1 Propulsion System Performance Indicators

The following instrumentation shall be installed for each engine pod: engine thrust indication, inlet pressure recovery, inlet shock position, inlet throat area, engine speed, exhaust gas temperatures, engine nozzle position, oil temperature, oil pressure, oil quantity, fuel temperature, and fuel flow rate and consumption (see Figs. 6-3 through 6-9).

5.10.2 Airborne Vibration Monitoring System

An engine vibration monitoring system shall be installed. Controls and indicators for the system shall be located at the flight engineer's station.

## 5.11 AIRPLANE ACCESSORY DRIVE SYSTEM

Four airplane accessory drive systems, each powered by a shaft from its respective engine and located in the fixed portion of the wing, shall be provided. Each system shall include the following equipment:

- Gearbox
- Generator drive and associated generator
- Cabin air boost compressor
- Two hydraulic pumps (inboard engines only)
- One hydraulic pump (outboard engines only)
- Air turbine starter

The air turbine starter shall:

- Drive the engine through the gearbox for engine starting (see Par. 5.7)
- Drive the gearbox for ground checkout of the electrical, hydraulic, and air conditioning systems without engine operation
- Drive the cabin air boost compressor, through the gearbox, for cabin air conditioning on the ground
- Drive the gearbox in flight for powering the electrical and hydraulic systems and cabin air boost compressor in the event of shutdown of the engine normally powering the gearbox.

Individual disconnects shall be provided to permit disconnecting the generator drive from the gearbox, the air boost compressor from the gearbox, and the gearbox from the engine. The disconnect functions shall be accomplished by separate switches at the flight engineer's station. The ability to reconnect the generator drive, air boost compressor, or gearbox in flight shall not be a requirement.

Each accessory drive system shall have an independent lubrication system with scavenge and supply strainers. The lubricant used in these systems shall be the same specified for use in the engine and accessories driven by the accessory drive system. Availability of this lubricant shall not be limited to a single source.

Cockpit indication of abnormal accessory drive system operation shall be provided.

## 5.12 FUEL SYSTEM

### 5.12.1 General Description

An independent fuel system shall be provided for each engine, interconnected by a crossfeed manifold line so that fuel may be delivered from any tank to any or all engines. Bladder-type fuel cells shall be used for containment of the fuel in the body lower lobe. Fuel within the wing shall be contained in integral or bladder-type tanks. Means shall not be provided to transfer fuel between tanks in flight. Ground transfer of fuel between tanks shall be provided (see Fig. 5-3).

#### 5.12.1.1 Altitude and Temperature

The fuel system shall be suitable for operation at the altitude and temperature conditions specified in Par. 3.4. Aerodynamic heating, insulation, and location in the airplane shall be considered in the design of the fuel system. However, the temperature of the fuel delivered to the engine shall be at least 10°F above the freezing point of that particular fuel. The fuel temperature in the tanks on takeoff shall be limited to 100°F to satisfy cooling

requirements for the environmental control, hydraulic, and engine systems.

5.12.1.2 Engine Fuel Shutoff and Crossfeed Manifold Valves

Engine fuel shutoff and crossfeed manifold valves shall be d.c. operated and connected to the battery bus. Operation of only one valve shall be required to stop fuel flow to any one engine. Operation of this valve shall be controlled by the particular engine fire control switch as well as by a switch on the flight engineer's fuel panel.

5.12.2 Fuel Tanks

There shall be four main tanks and two auxiliary tanks (see Fig. 5-4). The total usable fuel capacity shall not be less than 38,920 U.S. gallons.

5.12.2.1 Sumps

Manually operated sump drain valves shall be provided in each tank to allow removal of water or complete drainage of the tank in the taxi attitude (wing sweep position fully forward). Drain valves shall be replaceable with fuel in the tank.

5.12.3 Fuel Boost Pumps

Each main and auxiliary tank shall be equipped with a.c. electrically powered boost pumps for delivering fuel to the engines. Each main tank boost pump shall be capable of delivering fuel at the required rate and pressure to the engine driven pump inlet throughout the operating range of the engine. Means shall be provided to prevent all pumps in a tank from becoming inoperative because of a single

electrical failure. The fuel boost pump installation shall be designed so that uncoordinated turns and rolls will not adversely affect engine operation. The boost pumps shall be replaceable without draining or entering the tank.

5.12.4 Fuel Lines

Fuel tubing shall be fabricated of aluminum alloy, titanium alloy, or stainless steel as appropriate. Fireproof tubing shall be used in all designated fire zones. Fuel lines shall be routed only through unpressurized areas. Shrouds shall be provided around fuel lines and/or fittings as necessary in potentially hazardous areas. Such shrouds shall be appropriately drained, shall be readily inspectable and replaceable, and shall be constructed of material that is completely fuel resistant under its installed environmental conditions. Flexible lines shall be used to carry fuel across the wing pivots.

5.12.5 Fuel Cleaning Devices

No in-line fuel filters or strainers shall be supplied. Each engine will provide its own filtration protection. Screens shall be installed at the fuel inlet ports of all boost pumps.

5.12.6 Fuel Vent System

An open, unpressurized vent system shall be installed to maintain fuel tanks and dry bay cavity pressures within design operating limits under the following conditions:

- Failure of a pressure fueling level control valve at the maximum fueling rate
- Maximum emergency descent rate with empty tanks

- Maximum rates of climb under all certificated operating conditions. (See Par. 5.1.1 for fuel definition.)

The vent system shall be designed to prevent draining, surging, or siphoning of fuel out of the vent outlets during any normal flight or ground handling maneuver of the airplane. The vent outlets for the auxiliary tanks shall be located on the outboard wing, and those for the main tanks shall be located in the aft body section.

5.12.7 Fuel System Instrumentation

5.12.7.1 Fuel Quantity Indication System

Six fuel quantity indicators located on the flight engineer's panel shall read pounds of fuel contained in each fuel tank; repeater indicators shall be located at one fueling station (see Par. 5.12.8). A single fuel indicator shall be installed on the flight engineer's panel to indicate total quantity of fuel in the airplane.

Measuring devices (drip sticks), operable on the ground, shall be installed in each fuel tank to determine the quantity of fuel remaining in each tank. The sticks shall be calibrated in inches. The drip sticks shall be replaceable without draining or entering the tank.

5.12.7.2 Fuel Flowmeters

A fuel consumed and rate-type gravimetric fuel flowmeter, calibrated in pounds, shall be provided for each engine. Fuel consumed and flow rate indication for each engine shall be provided on the flight engineer's panel. Flowmeters shall be installed with the objective of being self-bleeding.

Flowmeter fittings shall be designed to provide leak-free connections capable of accepting normal plumbing alignment tolerances.

5.12.7.3 Fuel Pressure Indication

A fuel low pressure warning light for each boost pump shall be installed on the flight engineer's panel.

5.12.7.4 Fuel Temperature Indication

Fuel temperature sensing bulbs shall be installed in each of the four main fuel tanks and in each of the two auxiliary fuel tanks. One fuel-temperature-sensing bulb shall be installed in the fuel feed line for each engine. Fuel temperature indicators shall be installed on the flight engineer's panel.

5.12.7.5 Fuel Valve Position Indication

A valve position light for monitoring valve actuation shall be placed adjacent to the control for each electric motor operated valve in the fuel engine feed, dump, and pressure fueling systems. Control switches on the fuel feed panel shall be oriented to indicate valve position.

5.12.8 Fueling System

Fueling shall be accomplished through a single manifold having two illuminated fueling stations, each with two nozzle connectors. No provisions shall be made for gravity fueling. During design of the fuel system, consideration shall be given to available knowledge concerning electrostatic discharge.

The fueling system shall be designed to be serviced with MS 29520 nozzles and fueling equipment having a maximum delivery pressure at the nozzle inlet of 50 psi. The fueling rate, with four nozzles, with such equipment shall be 1600 gpm minimum.

One fueling control panel shall incorporate the following:

- Fuel quantity indicator for each tank
- Test switch
- Fueling valve control switch for each tank
- Valve-in-transit light for each tank
- Electrical power switch
- Interphone jack

Automatic shutoff valves in each tank shall close at the full fuel level. Provisions shall be incorporated to prevent structural damage to the wing in the event of malfunction in the level control system, provided the fueling equipment pressure at the nozzle inlet does not exceed 55 psi. Means shall be provided to prevent damaging surges when fueling valves close.

5.12.9 Defueling

The defueling system shall use the fueling system manifold and adapters. A manual valve, operable only from the ground, shall connect the fueling manifold to the engine fuel feed system to allow use of the boost pumps in defueling. Using the crossfeed manifold, it shall be possible to defuel to the sump level. It shall not be possible to close the access panel to the manual valve with the valve in any position other than the closed position. It shall be possible to defuel to the design reserve level in any tank when the respective fuel dump valve is opened. Approximate defueling

rates attainable, using boost pumps, shall be 200 gpm per tank. It shall also be possible to defuel using suction.

5.12.10 Fuel Dump System

The fuel dump system shall use the pressure fueling system manifold and, through appropriate valving and controls, the fuel tank boost pumps (see Fig. 5-3). The fuel dump nozzle shall be located in the aft section of the airplane. The dump system shall automatically shut off to maintain the designed fuel reserves. It shall be possible to stop dumping at any higher level by use of the tank selector dump valve. All fuel dump system functions shall be controlled at the flight engineer's station.

5.12.11 Fuel System Checkout

The fuel system function may be checked by observation of the boost pump low pressure lights, shutoff and manifold valve-in-transit lights, and a fuel quantity indicator push-to-test feature provided at the flight engineer's panel.

5.12.12 Engine Fuel De-icing

Means shall be provided to prevent malfunction caused by freezing of moisture in the fuel.

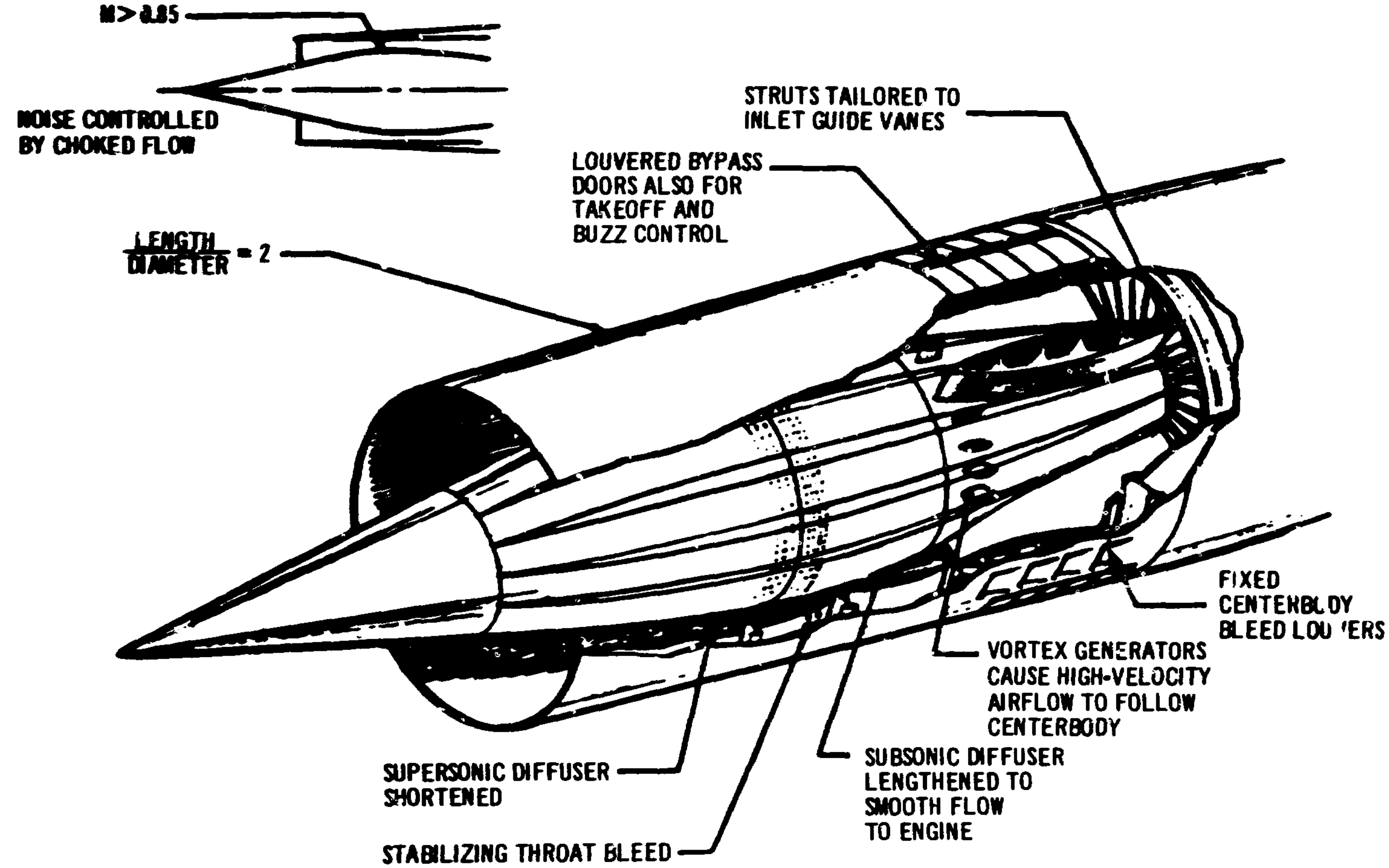



*Fig. 5-1 Inlet Arrangement*

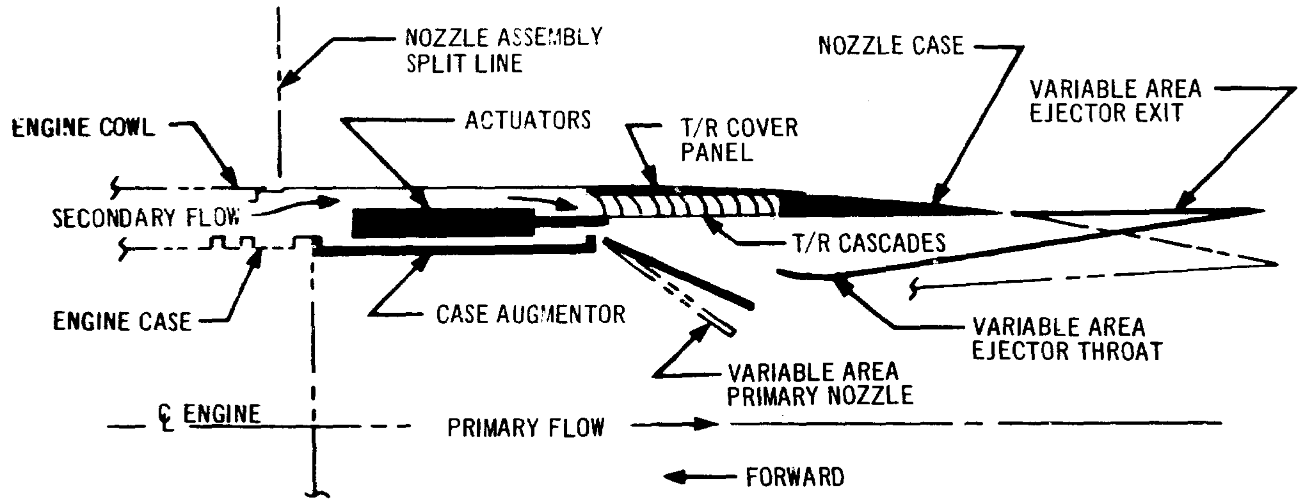



*Fig. 5-2 Exhaust System Arrangement*

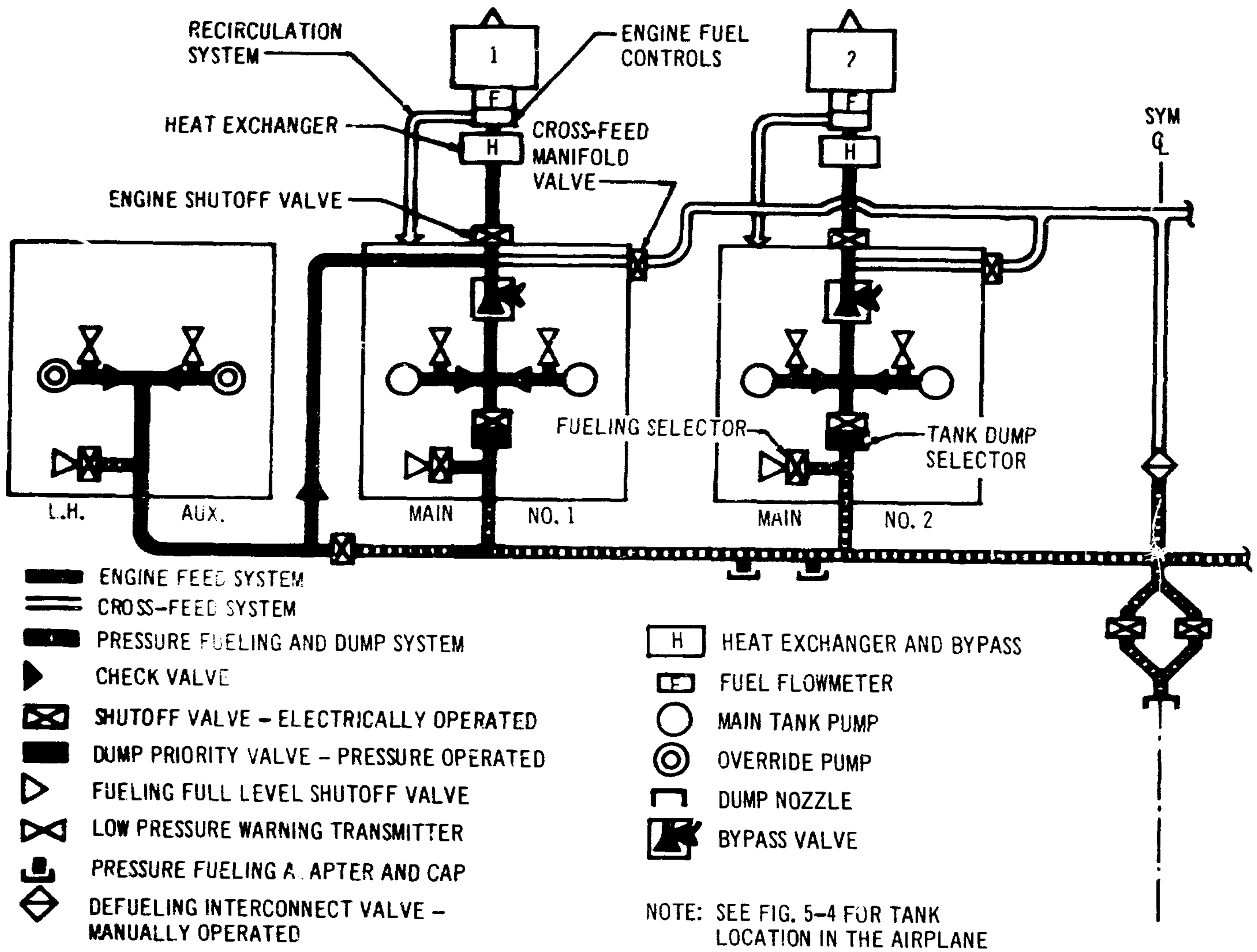



*Fig. 5–3 Fuel System*

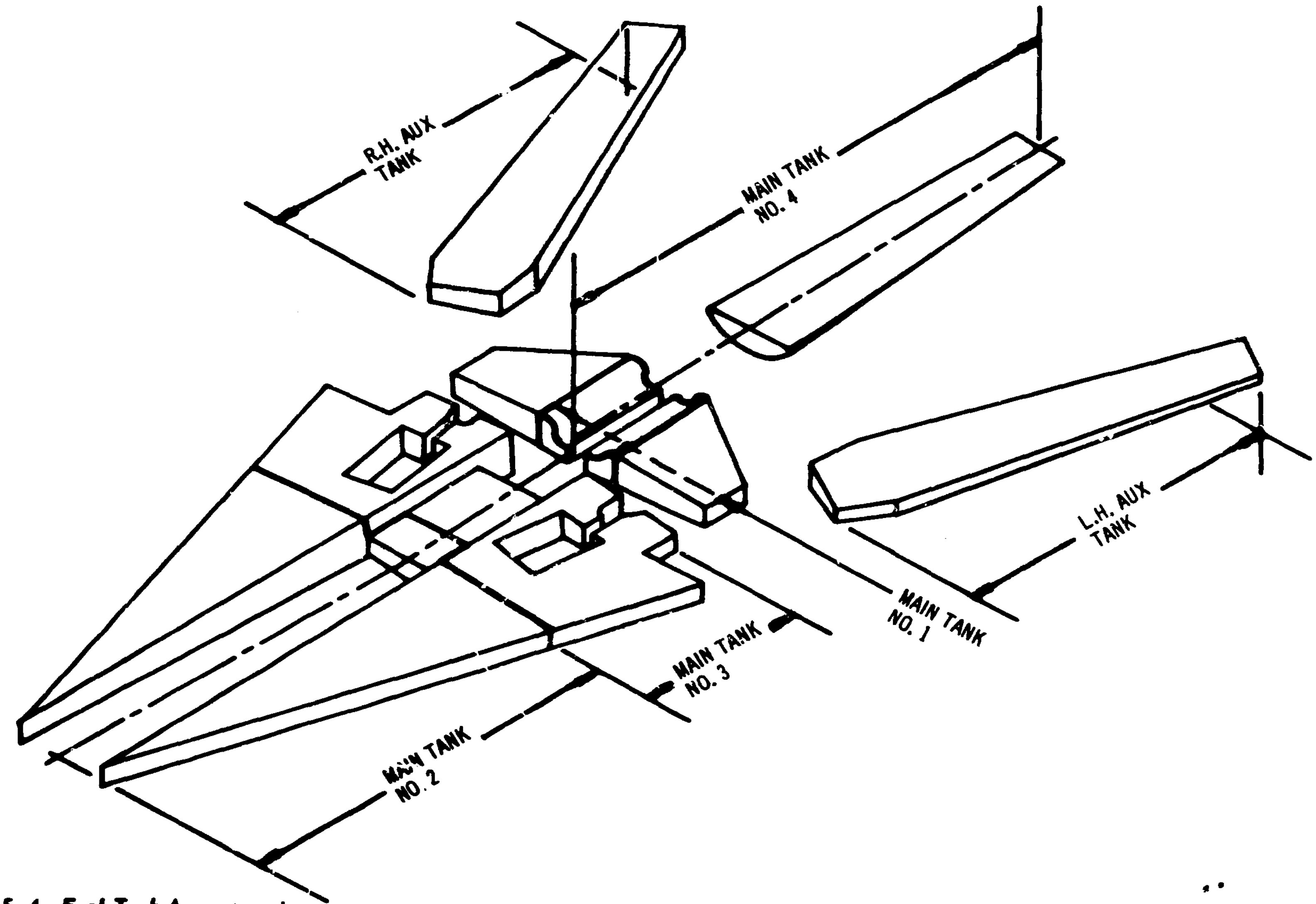



Fig. 5–4 Fuel Tank Arrangement

# 6.0 FLIGHT DECK ACCOMMODATIONS

CONTENTS

6.1.4 Stowage

Stowage shall be provided for crew coats and hats and for the captain's, first officer's, and flight engineer's flight kits. A check list/approach plate holder shall be provided at the captain's, first officer's, and flight engineer's stations. Waste containers shall be provided in the flight deck area.

6.1.5 Placards and Signs

Placards and signs on the flight deck shall be in the English language; however, placards and signs in other languages shall be available. A "No Admittance" placard shall be installed on the passenger cabin side of the electronics equipment area door.

6.2 CREW SEATS

6.2.1 Pilots' Seats

The captain's seat shall be reclinable and adjustable vertically and fore and aft; it shall be power operated fore and aft to facilitate monitoring the flight engineer's panel. The first officer's seat shall be reclinable and adjustable vertically, laterally, and fore and aft. To facilitate entry into the seats, folding arm rests shall be provided.

6.2.2 Flight Engineer's Seat

The flight engineer's seat shall swivel and be adjustable vertically, laterally, and fore and aft. It shall be power operated fore and aft to facilitate coordination with the pilots.

6.2.3 Observers' Seats

Seats for two observers shall be provided on the flight deck.

6.2.4 Seat Harnesses

Inertia-type seat harnesses shall be provided for the captain's, first officer's and flight engineer's positions. Noninertia-type seat harnesses shall be provided for the observers' positions.

6.2.5 Seat Loads

All flight deck seats shall be designed for the following ultimate load factors acting separately: forward, 16g (acting within a 20-degree angle to either side of forward); upward, 5.5g; and downward, 8.5g.

## 6.3 EMERGENCY EQUIPMENT

Emergency equipment described herein shall be located in the flight deck area. Portable emergency equipment shall be readily accessible and positively identified.

6.3.1 Fire Extinguishers

One water and one $CO_2$ hand fire extinguisher shall be provided.

6.3.2 Life Jackets

One life jacket shall be stowed at each crew seat.

6.3.3 **Escape Facilities**

Two emergency exits, with escape ropes attached to airplane structure, shall be provided in the flight deck area.

6.3.4 Smoke Goggles

One pair of smoke goggles shall be provided at the captain's, first officer's, flight engineer's, and first observer's stations.

6.3.5 Portable Oxygen

An emergency portable oxygen bottle shall be located in the flight deck area. It shall have a capacity of 3.8 cubic feet at 760 millimeters of mercury and 70°F. It shall include a pressure reducing device and a quick-disconnect coupling for an oxygen mask hose. It shall be possible to recharge the bottle from the airplane oxygen system.

6.4 FLIGHT CREW OXYGEN SYSTEM

The flight crew oxygen system shall be substantially as shown in Fig. 11-7. One oxygen cylinder, having a capacity of 29 cubic feet at 760 millimeters of mercury and 70°F, shall be installed in parallel with a 25-liter capacity liquid oxygen converter and evaporation coil assembly of the passenger oxygen system. (See Par. 11.5 for a description of the passenger oxygen system.)

Stowage shall be provided at each flight deck station for a pressure breathing mask and a mask mounted regulator. A

quick-disconnect coupling shall be provided for connecting the mask hose to the airplane supply line.

Sufficient oxygen shall be provided for 1.5 hours of flight for one pilot, with the pressure demand regulator set at NORMAL under a cabin pressure equivalent to the nominal 6000-foot altitude. In addition, there shall be sufficient oxygen for 3 hours of postdecompression flight for five crew members, including 10 minutes of emergency descent from 70,000 to 14,000 feet altitude and continued subsonic cruise at that altitude, based on a 20-liter per minute BTPS breathing volume for each crew member.

## 6.5 INSTRUMENTS AND CONTROL PANELS

### 6.5.1 Standards

The SAE Aeronautical Recommended Practices and Aerospace Standards shall be used as a guide in the arrangement of the flight deck area.

The arrangement and presentation of flight deck instrumentation and controls will reflect airline experience with Boeing subsonic jet aircraft. However, where advisable, logical changes resulting from technological advancements or the operating requirements of the airplane will be incorporated.

### 6.5.2 Instrument Panel Mounting

Instrument panels shall not be shock mounted. Vibrators shall be provided as required to reduce instrument friction error.

6.5.3 Flexible Lines

Flexible lines shall be provided at pressure operated instruments to facilitate removal and servicing of instruments and panels. The design shall ensure that connectors cannot be mismated.

6.5.4 Instrument Wiring

Wherever practical, electrical instruments shall have individual instrument connectors. Flexible wire bundles shall be provided where necessary to permit the instrument panels to be opened. The design shall ensure that connectors cannot be mismated.

6.5.5 Instrument Mounting

Where practical, all instruments shall be front mounted.

6.5.6 Instrument Faces

Instrument faces, graduations, numerals, and pointers shall be color contrasted or equivalent to ensure ease of reading.

6.5.7 Instrument Markings

Appropriate instrument limit and operating range markings shall be provided.

6.5.8 Instrument Lighting

See Par. 9.11 for instrument lighting.

6.5.9 General

The flight, engine, and miscellaneous instruments specified in Appendix I shall be installed.

Instrument References:

- Power Plant and Fuel System -- Chapter 5.0
- Electrical System -- Chapter 9.0
- Hydraulic System -- Chapter 8.0
- Pneumatic System -- Chapter 8.0
- Flight Control System -- Chapter 7.0
- Air Conditioning and Pressurization -- Chapter 12.0
- Anti-icing and Antifogging -- Chapter 12.0

## 6.6 PITOT-STATIC SYSTEM

A primary and secondary pitot-static system shall be provided as shown in Fig. 6-2. The primary system shall consist of a single nose-mounted probe, providing two pneumatically independent pitot sources and two pneumatically independent static sources to supply pitot and static pressures to the two air data computers under normal operating conditions.

The secondary pitot-static system shall consist of two body-mounted pitot probes and four independent flush static sources. The No. 1 pitot probe and No. 1 static source shall supply pressures to the captain's pneumatic instruments. The No. 2 pitot probe and No. 2 static source shall be connected to the first officer's pneumatic instruments. The No. 2 pitot probe and No. 3 static source shall supply pressures to the flight recorder system and other auxiliary equipment.

A pitot shutoff valve shall be provided to enable isolation of the auxiliary equipment from the first officer's pneumatic

instrument system. Selector valves shall be provided to enable operation of the air data computers from either the primary pitot-static system or the secondary pitot-static system.

The nose probe and the body-mounted pitot probes shall be electrically de-iced. Adequate water collection traps, drainage provisions, and test fittings shall be provided.

The autopilot shall receive air data information from the air data computers, and the altimeter and airspeed indications shall be corrected for position error by air data computer inputs.

## 6.7 CONTROL PANELS

The arrangement of the control panels in the flight deck area shall be substantially as shown on the following figures:

| | |
|---|---|
| Pilots' Main Instrument Panel | Figure 6-3 |
| Pilots' Overhead Panel | Figure 6-4 |
| Pilots' Side Panels | Figure 6-5 |
| Pilots' Control Stand | Figure 6-6 |
| Flight Engineer's Upper Panel | Figure 6-7 |
| Flight Engineer's Lower Panel | Figure 6-8 |
| Flight Engineer's Forward Panel | Figure 6-9 |
| Observers' Panels | Figure 6-10 |

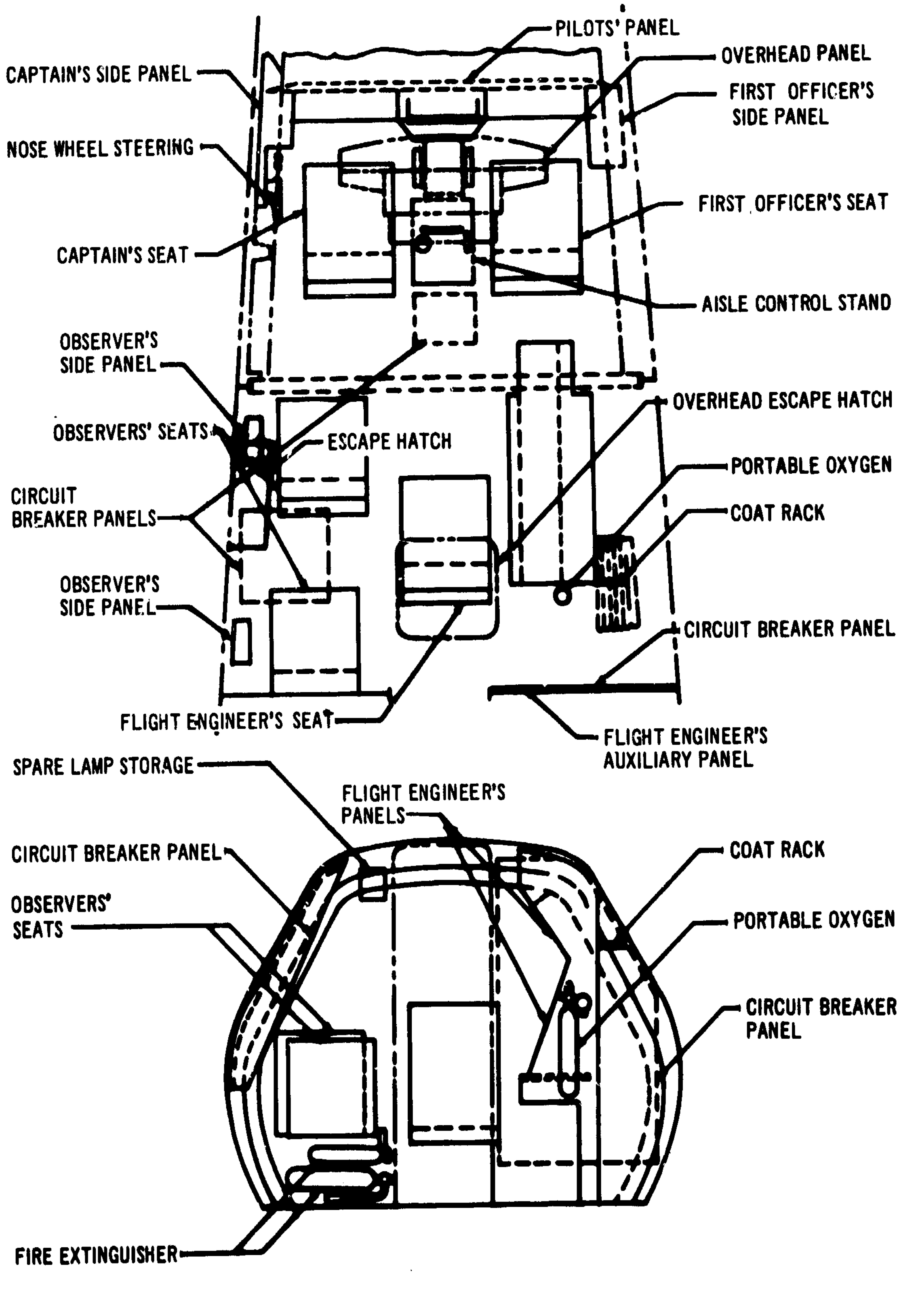



*Fig. 6-1 Flight Deck Arrangement*

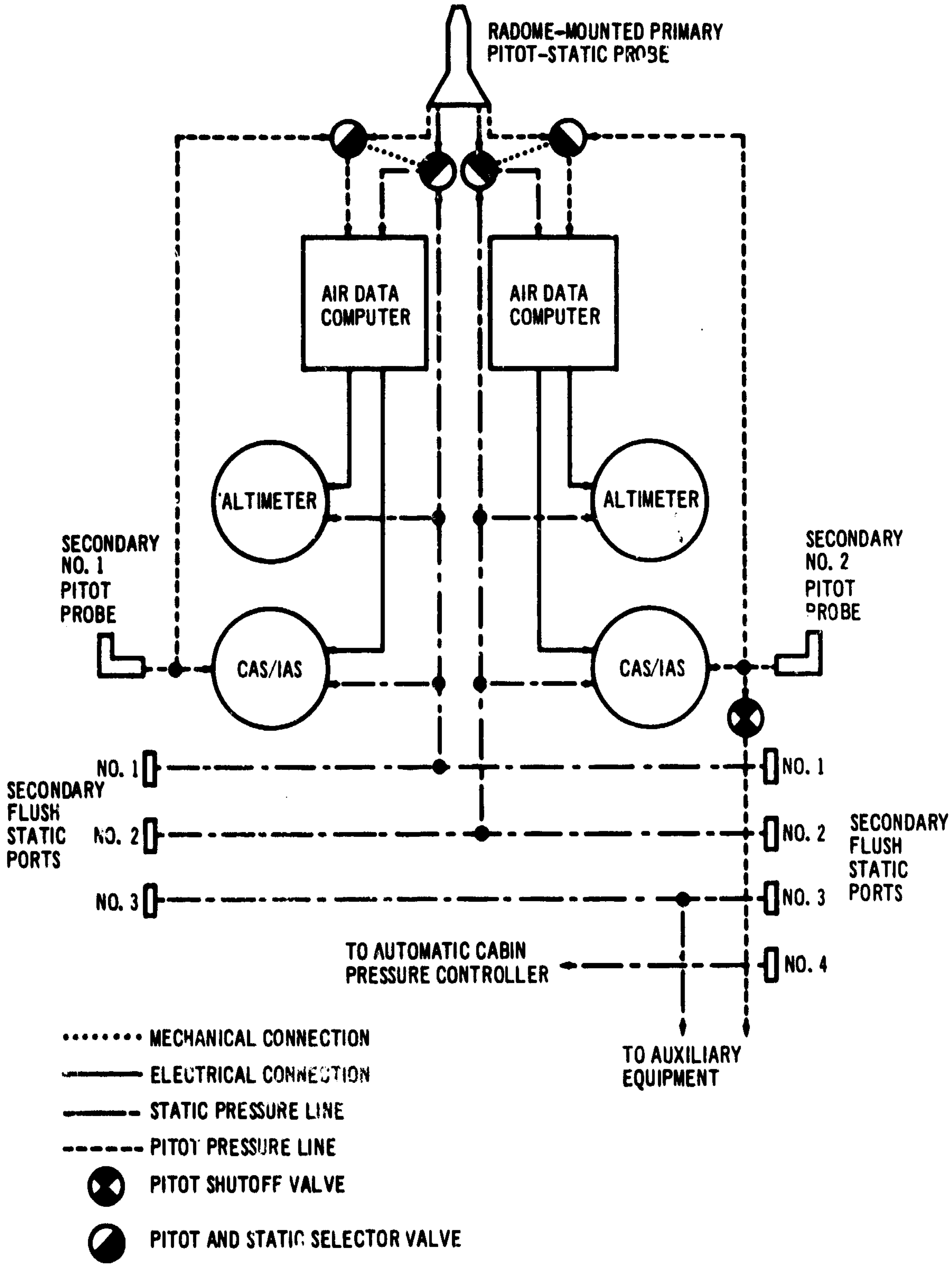
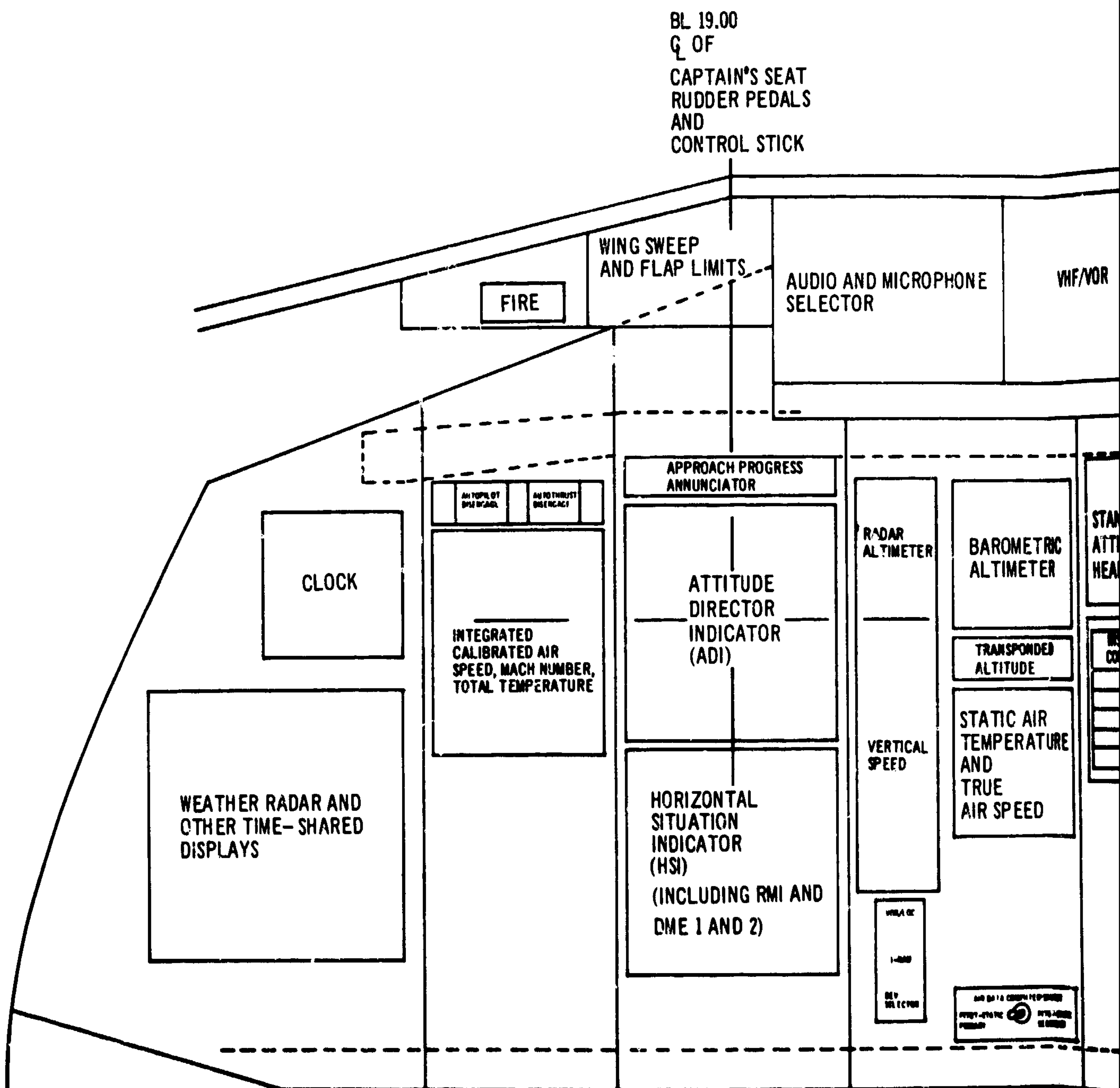



***Fig. 6-2 Pitot-Static System Diagram***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ANNUNCIATOR
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CALIBRATED AIR
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TOTAL TEMPERATURE
ATTITUDE
DIRECTOR
INDICATOR
(ADI)
RADAR
ALTIMETER
BAROMETRIC
ALTIMETER
TRANSPONDED
ALTITUDE
VERTICAL
SPEED
STATIC AIR
TEMPERATURE
AND
TRUE
AIR SPEED
WEATHER RADAR AND
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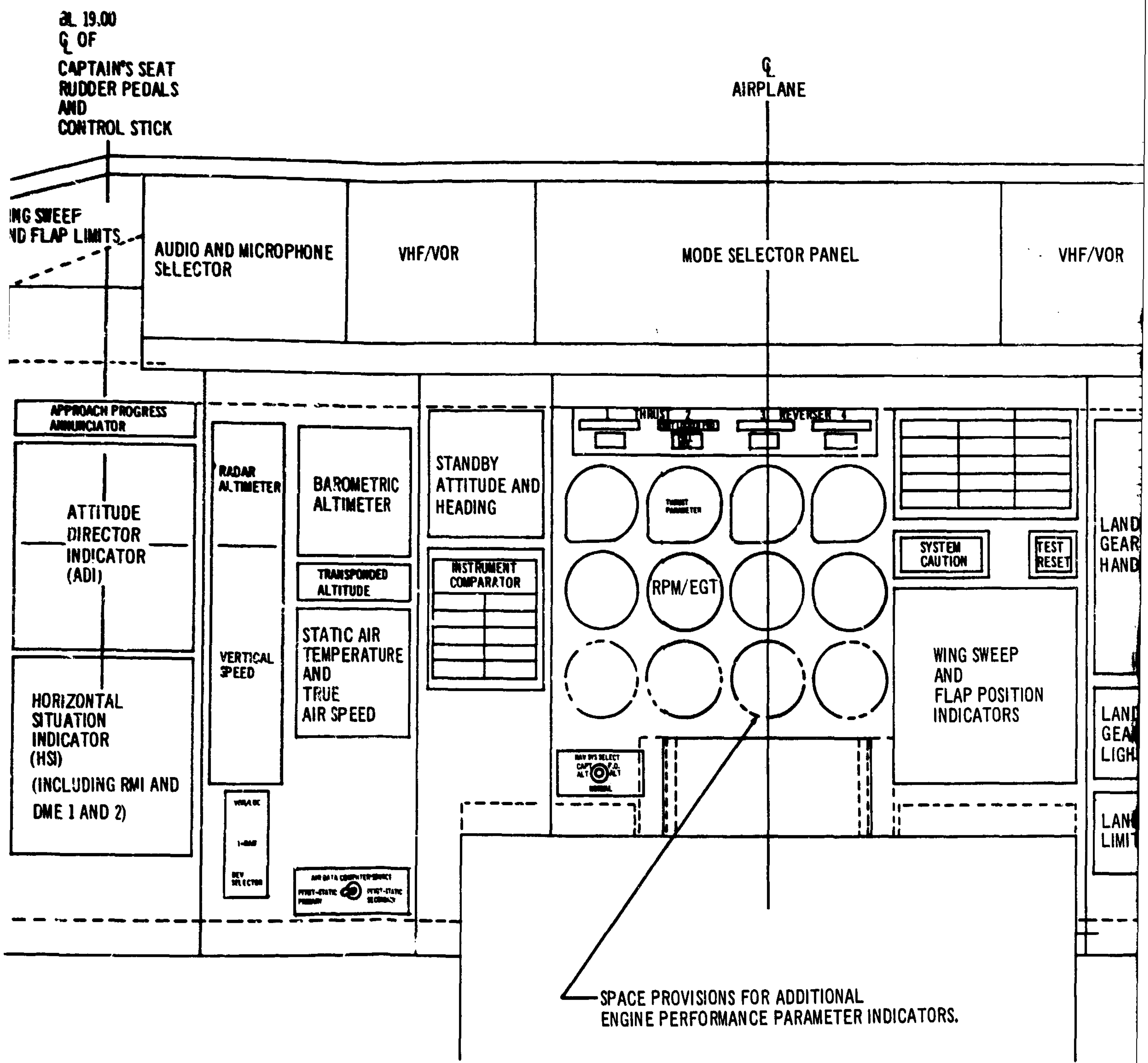

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MODE SELECTOR PANEL
VHF/VOR
APPROACH PROGRESS ANNUNCIATOR
ATTITUDE DIRECTOR INDICATOR (ADI)
HORIZONTAL SITUATION INDICATOR (HSI) (INCLUDING RMI AND DME 1 AND 2)
RADAR ALTIMETER
VERTICAL SPEED
BAROMETRIC ALTIMETER
TRANSPONDED ALTITUDE
STATIC AIR TEMPERATURE AND TRUE AIR SPEED
STANDBY ATTITUDE AND HEADING
INSTRUMENT COMPARATOR
1 THRUST 2 3 REVERSER 4
RPM/EGT
SYSTEM CAUTION
TEST RESET
WING SWEEP AND FLAP POSITION INDICATORS
LAND GEAR HAND
LAND GEAR LIGH
LAND LIMIT
SPACE PROVISIONS FOR ADDITIONAL ENGINE PERFORMANCE PARAMETER INDICATORS.

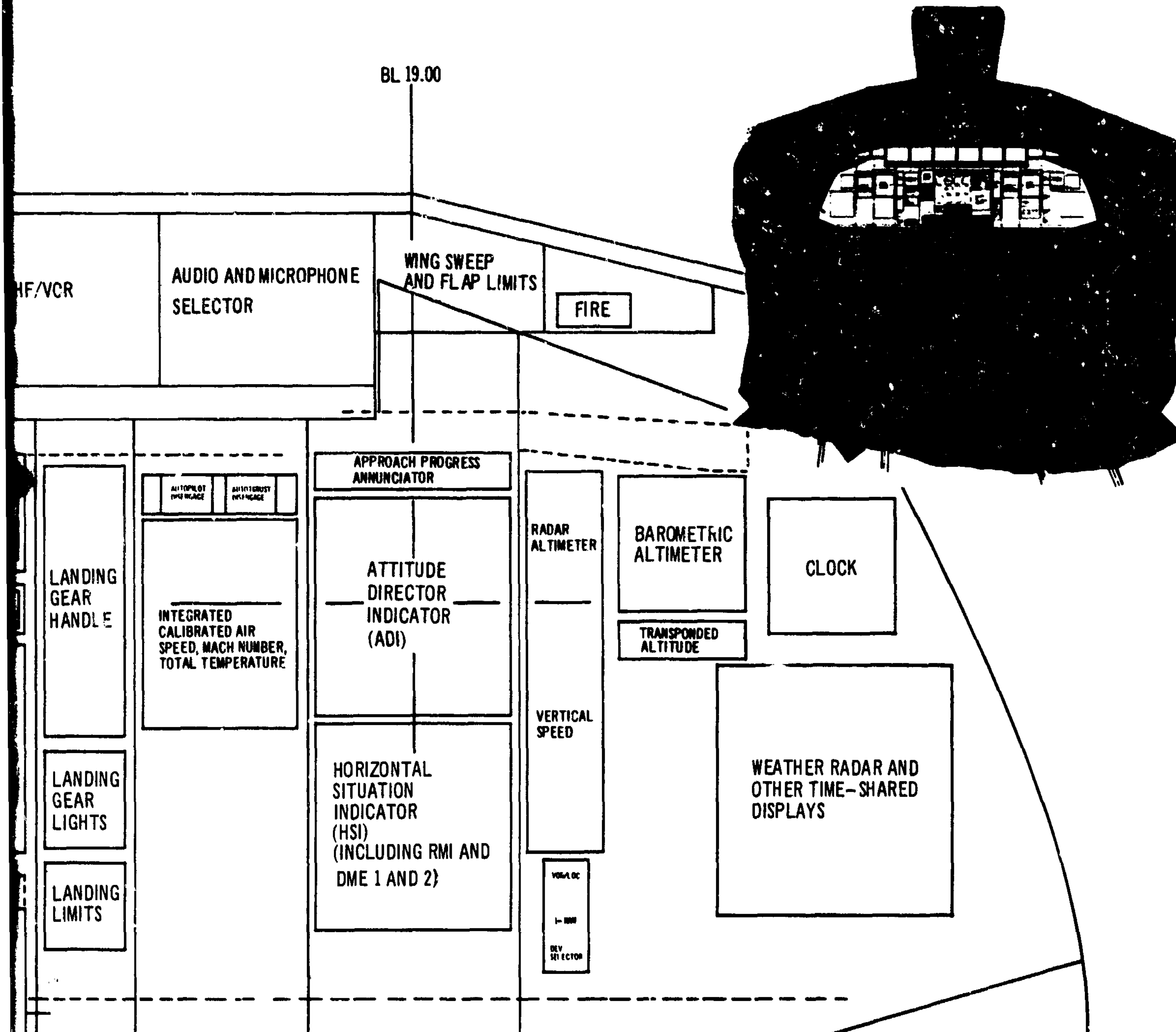


*Fig. 6-3 Pilots' Main Instrument Panel*

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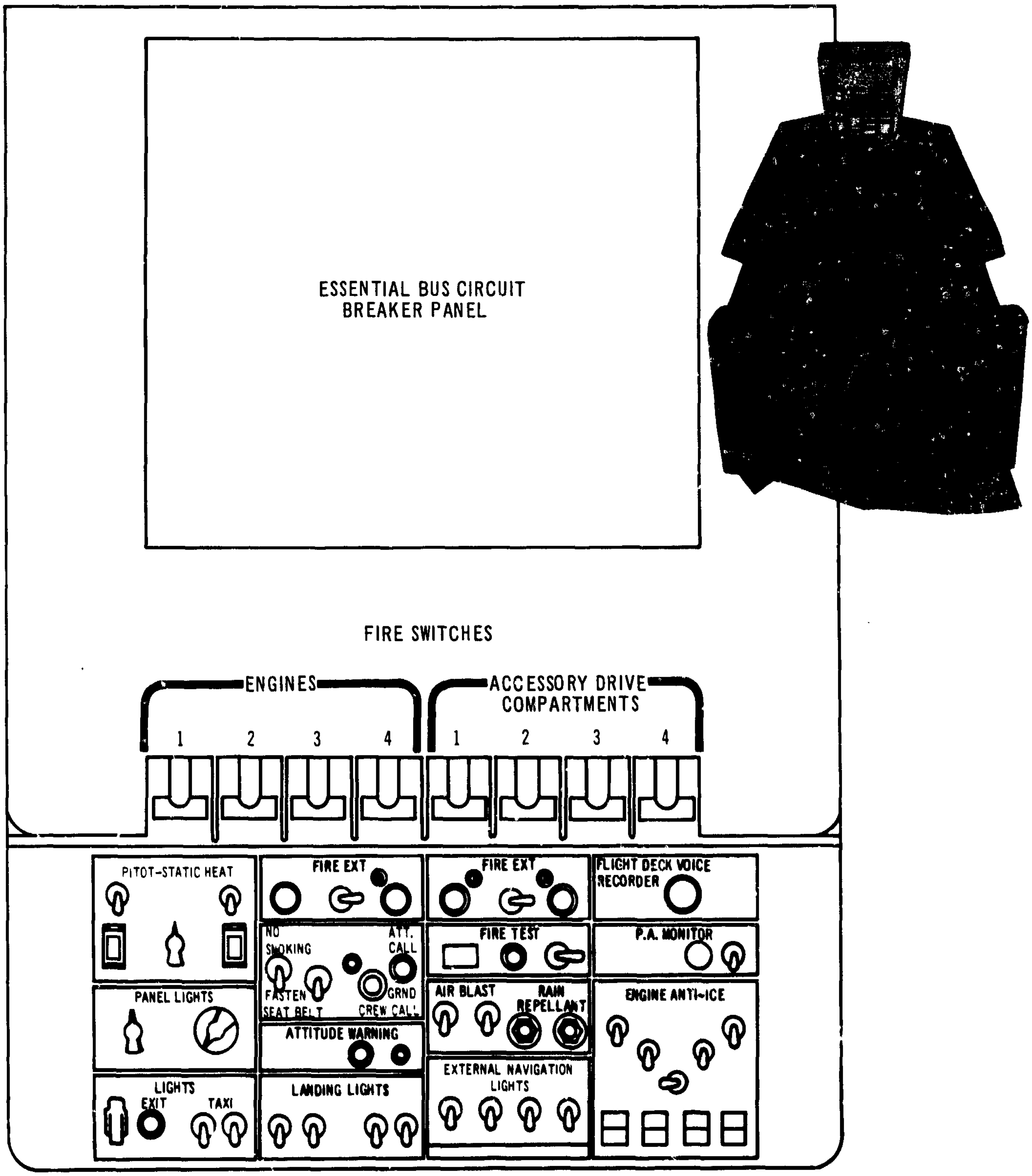


*Fig. 6-4 Pilots' Overhead Panel*

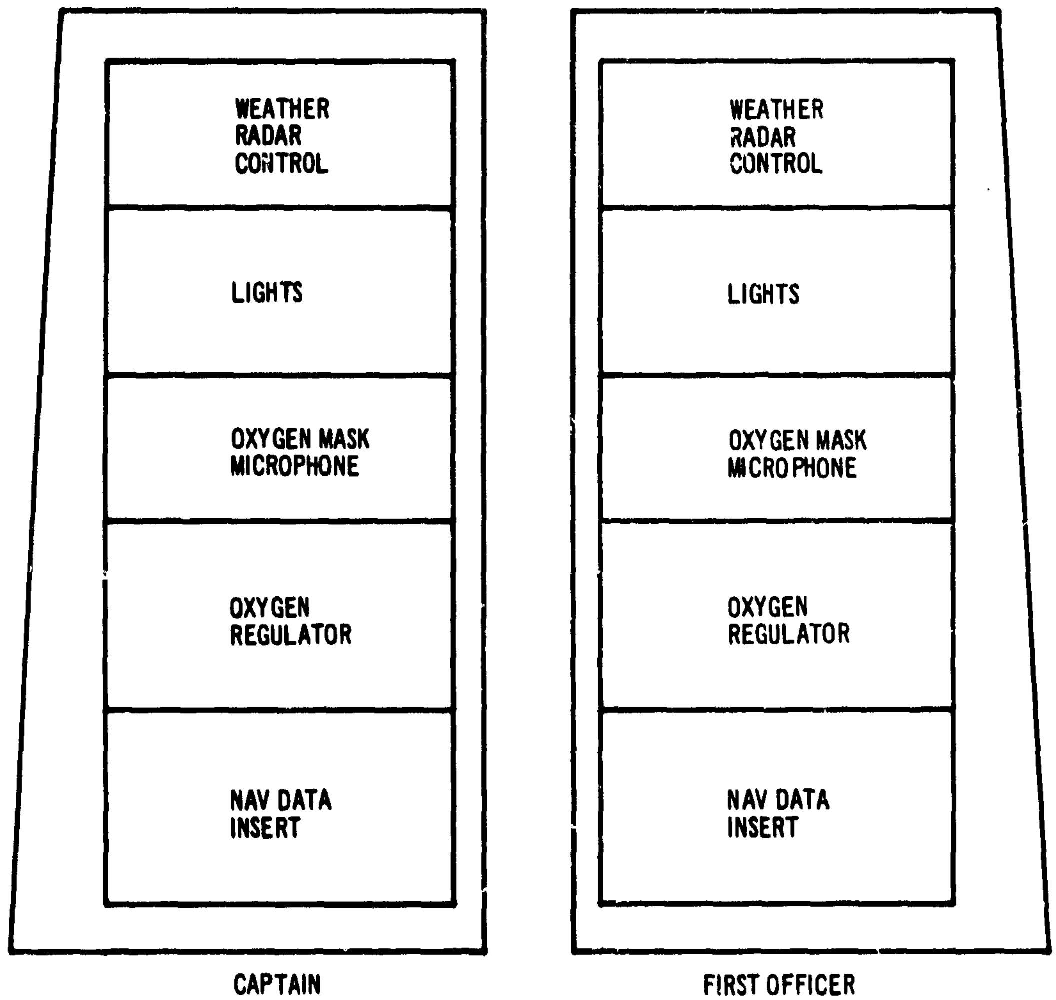


*Fig. 6–5 Pilots' Side Panels*

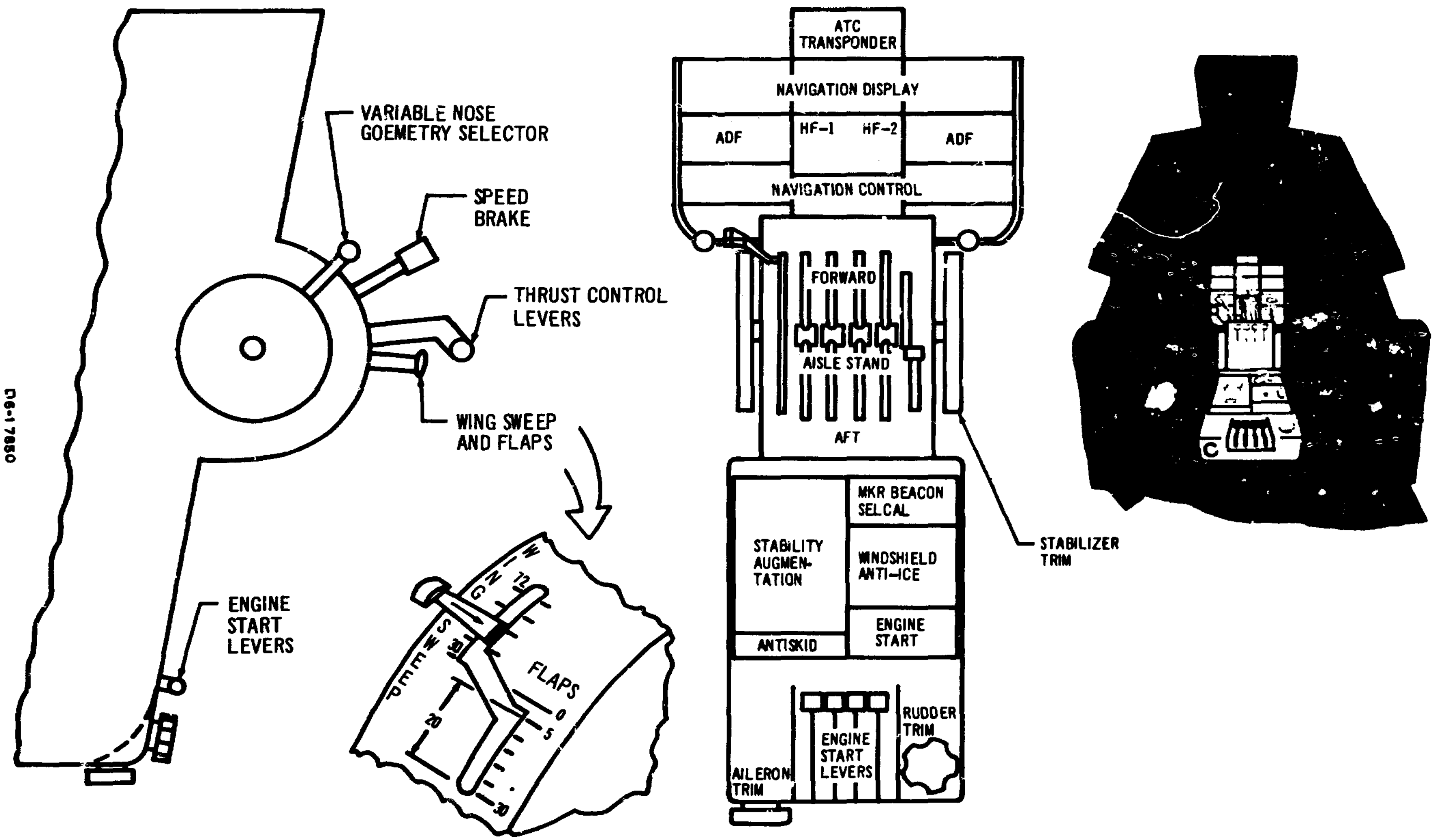


*Fig. 6–6 Pilots' Control Stand*

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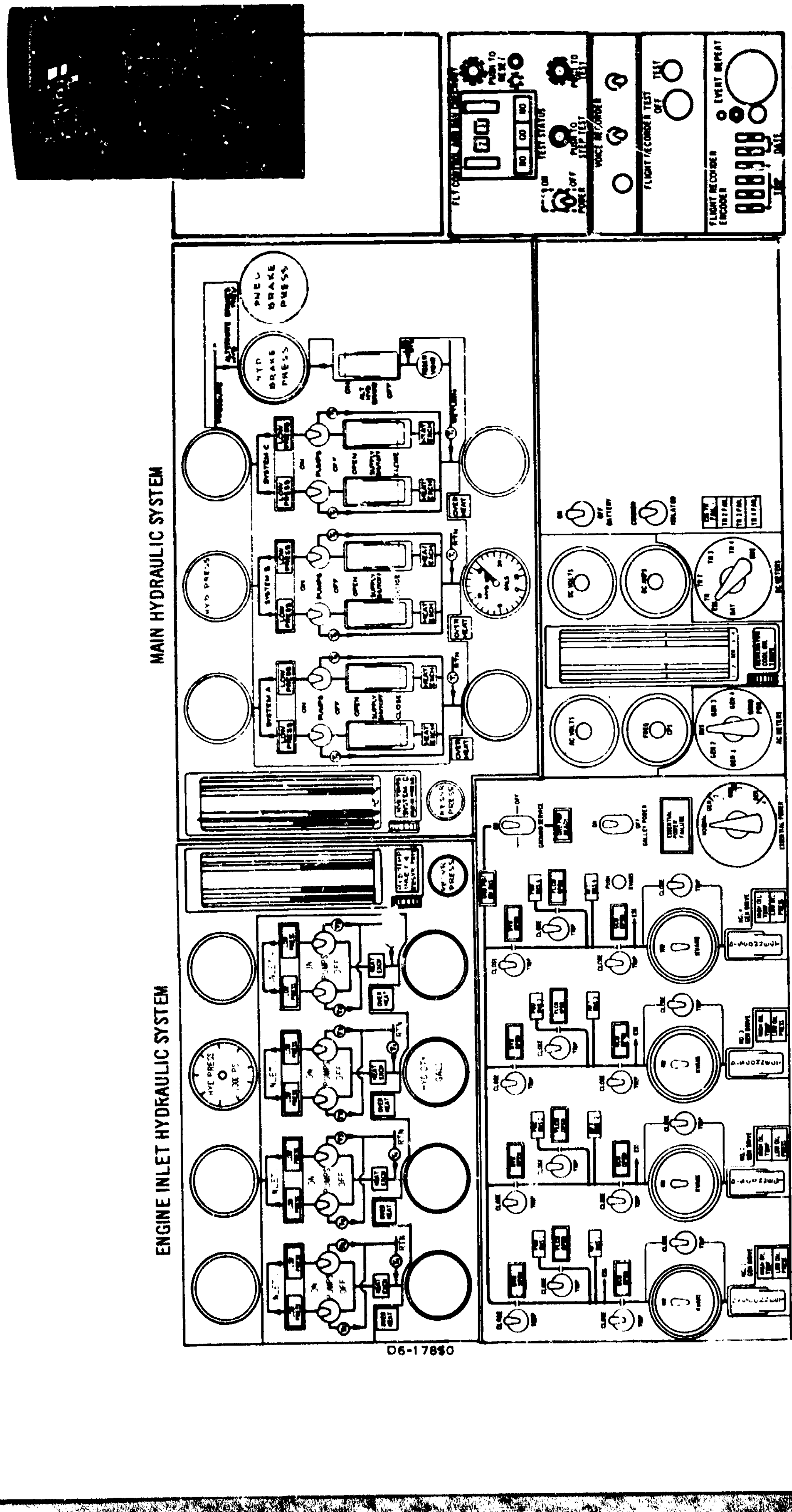


*Fig. 6-7 Flight Engineer's Upper Panel*

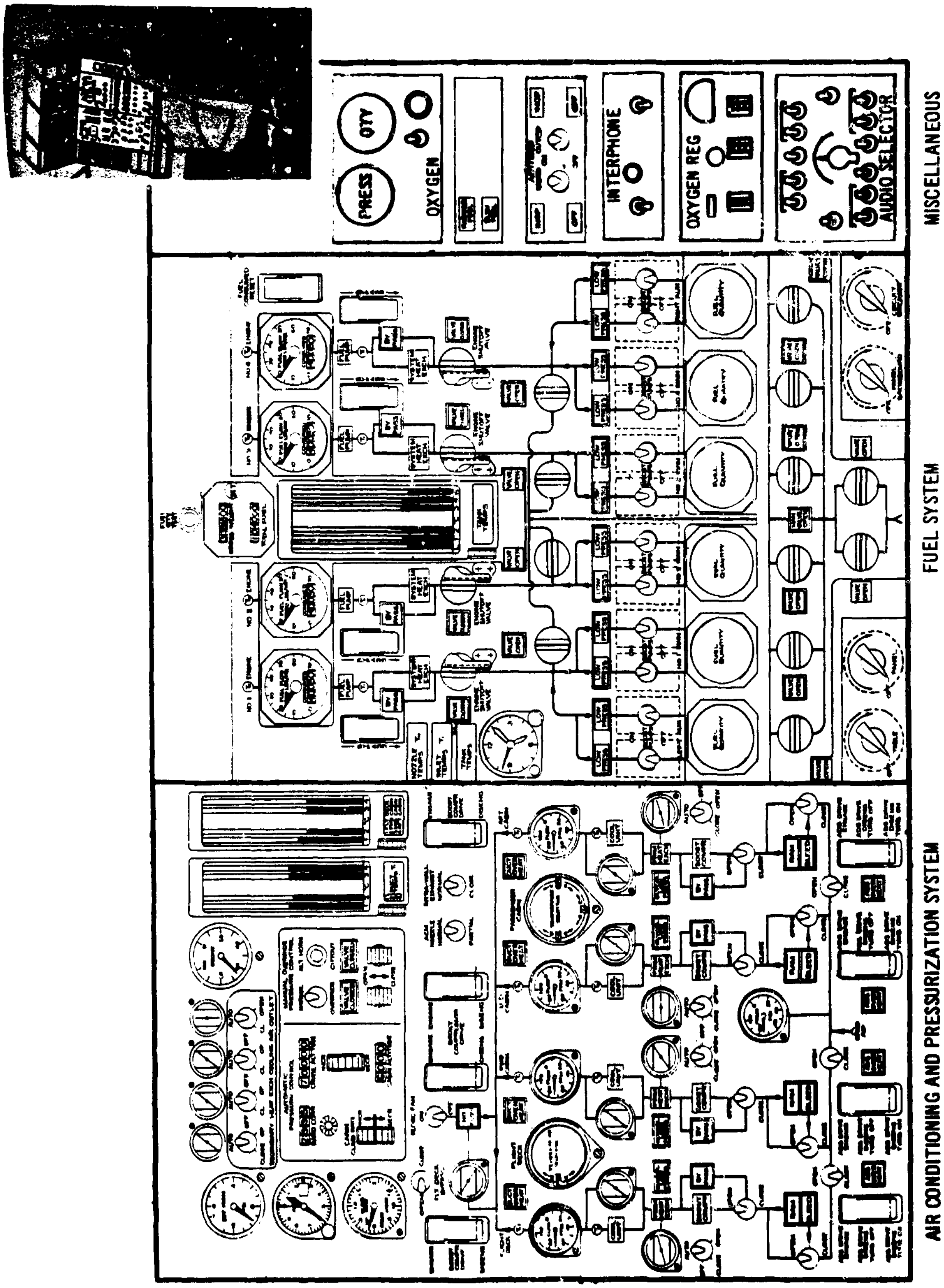


*Fig. 6–8 Flight Engineer's Lower Panel*

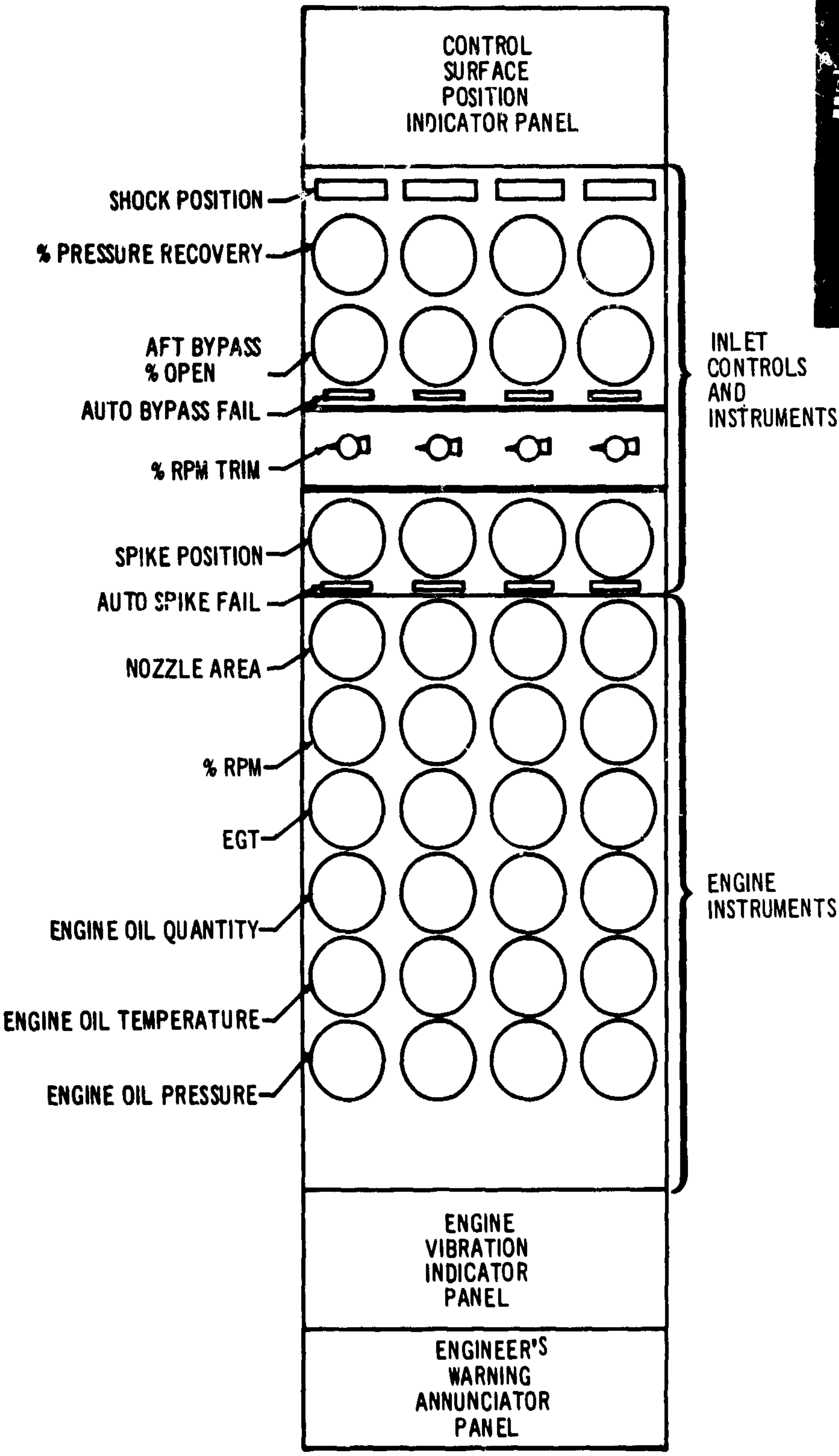


*Fig. 6-9 Flight Engineer's Forward Panel*

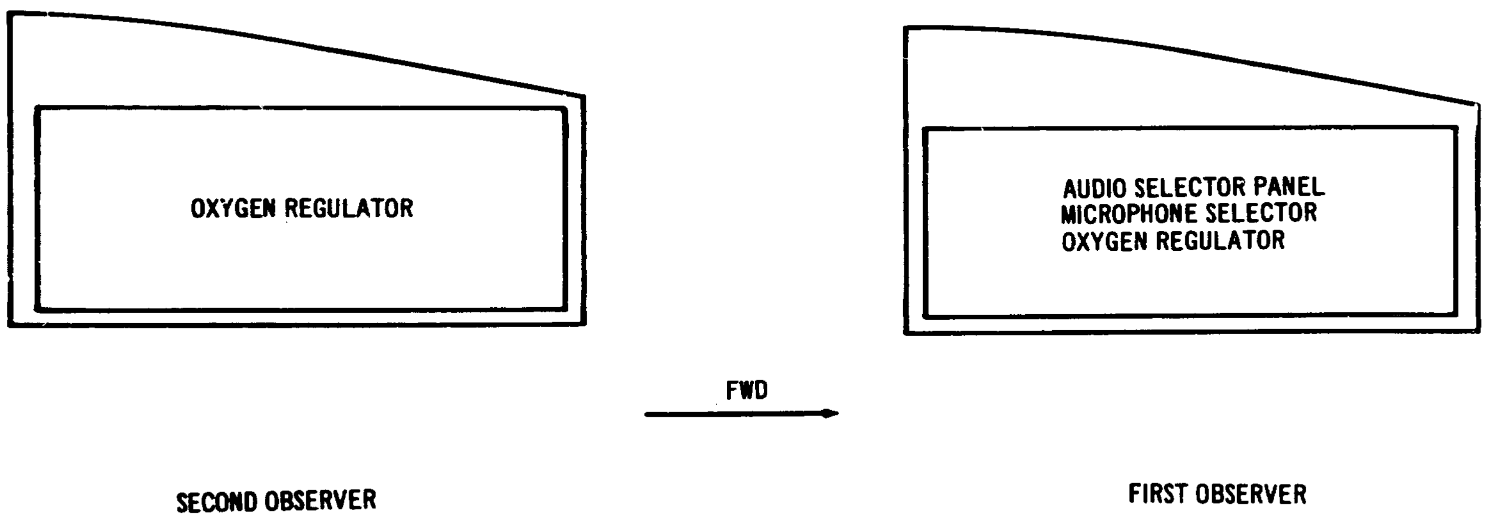


*Fig. 6–10 Observers' Panels*

# 7.0 FLIGHT CONTROLS

CONTENTS

# 7.0 FLIGHT CONTROLS

## 7.1 GENERAL

### 7.1.1 Control Systems

The surface control systems shall include controls for horizontal stabilizer, ailerons, spoilers, rudder, wing flaps, leading edge devices, and wing sweep. Indicators shall be located in the flight deck area for each of these control elements.

The flight control systems shall be fully powered, supplied by either two or three independent hydraulic systems (see Par. 8.1.2). No reversion to manual power shall be provided.

A dual electrical command system shall be installed to provide the principal control signals to the hydraulic power packages in the lateral and longitudinal axes. The electrical command system shall control the stabilizer and all aileron and spoiler panels and shall reposition the pilots' control sticks. In the event of failure of both electrical command units, the surface power control units shall be controlled by a mechanical cable system.

The rudder power unit shall be controlled by a mechanical cable system only.

A three-channel stability augmentation system shall be provided for each of the three axes and shall be integrated into the basic flight control systems. Stability augmentation signals shall be introduced in series with the pilots' and autopilot signals and limited in control authority by mechanical means.

In all three control axes, artificial feel that meets pilot force travel requirements throughout the flight envelope shall be incorporated. The feel system neutral points in the directional and lateral control systems shall be adjustable to produce the desired trimmed position of the respective control surfaces. Trim of the longitudinal control system shall be through an independent input into the stabilizer power control unit follow-up linkage.

Loss of power from all four engines shall not result in loss of flight control.

7.1.2 Component Fabrication

Control cable quadrants, brackets, cranks, and levers shall be fabricated from steel, titanium alloy, or aluminum alloy in the form of forgings, castings, or sheet or bar stock. Flexible steel control cables shall be used.

7.1.3 Rubbing Strips and Grommets

Rubbing strips and grommets shall be used to minimize cable wear, to maintain cable alignment under slack conditions, and to prevent damage to adjacent structure but shall not be used to change cable direction. Grommet diameter shall be sufficient to allow passage of cable terminals during rigging. Positive retention of pressure seals shall be provided where cables pass between areas of pressure differential.

7.1.4 Bearings

Prelubricated antifriction bearings and plain bearings shall be used throughout the flight control systems.

7.1.5 Gust Locks

Control surfaces shall be protected against damage caused by air gust loads up to 70 mph on the ground by mechanical locks or by the blocking of fluid flow through the actuators.

## 7.2 PRIMARY FLIGHT CONTROLS

### 7.2.1 Longitudinal Control

Longitudinal control shall be provided by the horizontal stabilizer (see Par. 8.1.2) having a system redundancy equivalent to, or better than, that provided on present day subsonic jet airplane. The horizontal stabilizer shall have a movable trailing edge to increase control capability at low speeds.

Stability augmentation control signals shall be applied to the horizontal stabilizer in series with the position follow-up linkages at the actuator power control package and shall not cause control stick movement.

### 7.2.2 Lateral Control

Lateral control shall be provided by inboard and outboard ailerons and spoilers (see Pars. 7.3.1.4 and 8.1.2). The outboard ailerons shall function only at low speeds and shall be automatically locked in neutral when the wing flaps are fully retracted. The inboard ailerons shall function at all wing flap settings and shall augment the high lift system by drooping proportional to wing flap extension (see Par. 7.3.1.2). Spoiler deflection shall be a function of the movement of the inboard ailerons from neutral.

Stability augmentation control signals shall be applied to the inboard ailerons in series with the position follow-up linkages to the hydraulic power packages and shall not cause control stick movement.

7.2.3 Directional Control

Directional control shall be provided by a rudder with deflection limited as a function of Mach number (see Par. 8.1.2).

Stability augmentation control signals shall be applied to the rudder in series with the position follow-up linkages to the hydraulic power packages and shall not cause rudder pedal movement.

7.2.4 Wing Sweep

The wing sweep actuation system, including the actuators and the differential gearbox, shall be designed with dual structural and actuation paths. Wing sweep shall be provided by two identical ball bearing screw actuators, one attached to each movable wing near the pivot. The actuators shall be operated through a dual torque tube drive from a common differential gearbox driven by three hydraulic motors, each of which shall be supplied by a separate hydraulic system. (See Par. 8.1.15 for associated hydraulic system requirements.)

An automatic shutoff system shall ensure that asymmetric wing sweep does not result from any failure in the sweep mechanism. Thrust brakes in each screw actuator shall make the actuators irreversible.

Wing sweep and wing flap controls shall be integrated into a single lever on the aisle control stand. The system shall prevent structural interferences and ensure proper sequencing with other control surface movements (see Par. 7.3.1.2).

7.3 SECONDARY FLIGHT CONTROLS

7.3.1 Lift- and Drag-Increasing Devices

7.3.1.1 General

The lift- and drag-increasing devices shall consist of trailing edge flaps including the ailerons in the drooped position, leading edge devices, and speed brakes (spoilers).

7.3.1.2 Trailing Edge Flaps

One inboard and one strake and outboard wing trailing edge flap system shall be provided. Flap actuation shall be by two independent mechanical systems, one for the outboard and strake flaps and one for the inboard movable wing flaps. The inboard ailerons shall be tied directly into the outboard

and strake trailing edge flap system to make aileron droop proportional to flap extension. Each flap system shall be actuated by ball bearing screw actuators driven by adjacent gearboxes. These gearboxes shall be driven by torque tubes that are connected with gearboxes each powered by two hydraulic motors (see Par. 8.1.2). In both inboard and outboard flap systems, the torque tubes shall incorporate sliding splines in the wing pivot area. If either hydraulic system powering one of the above gearboxes fails, the remaining hydraulic system shall be capable of providing flap movement. Each drive system shall provide automatic asymmetric flap shutoff.

The flaps shall be controlled by the lever described in Par. 7.2.4 (see Fig.6-6). Simultaneous selection of wing sweep and flap extension, in the range where structural interference could occur, shall not be possible.

Feedback of wing sweep or flap position shall be incorporated in the flap control system so that surface motion is proportional to control lever movement.

Extending the outboard and strake flaps, the strake slats, and drooping ailerons can also be accomplished with the wings in the aft position by use of an alternate flap control lever.

7.3.1.3 Leading Edge Devices

The leading edge devices shall be operated by mechanical screw jack actuators. The actuators shall be powered through sliding spline torque tubes at the wing pivot from a gearbox driven by two independently powered hydraulic motors (see Par. 8.1.2). If either hydraulic system fails, the remaining system shall be capable of actuating the leading edge devices.

The leading edge devices shall be extended and retracted concurrently with the trailing edge flaps.

7.3.1.4 Speed Brakes

Speed braking shall be provided by symmetric extension of the spoilers. Control of the spoilers for aerodynamic braking shall be by a lever, labeled SPEED BRAKE, on the center aisle control stand.

7.3.2 Trim Control Systems

Longitudinal trim shall be controlled electrically by switches located on the pilots' control sticks and mechanically by manual trim wheels on the aisle control stand. Mechanical lateral and directional trim controls, located on the stand, shall be oriented in the axis being trimmed. Trim position indicators shall be provided for each trim control and shall be located on the control stand.

7.3.2.1 Longitudinal Trim

Longitudinal trim shall be accomplished by movement of the horizontal stabilizer. This shall be accomplished by the trim control system through the horizontal stabilizer power control package.

7.3.2.2 Lateral Trim

Lateral trim shall be accomplished by the manual trim control, which shall reposition the neutral point of the lateral feel system and control the hydraulic power packages at the ailerons.

7.3.2.3 Directional Trim

Directional trim shall be accomplished by the manual trim control which shall reposition the neutral point of the rudder feel unit and control the hydraulic power package at the rudder.

## 7.4 AUTOMATIC FLIGHT CONTROLS

The automatic flight controls shall consist of a three-channel stability augmentation system for each axis and a dual-channel autopilot. The stability augmentation system shall have limited displacement authority and shall operate in series with the pilots' controls. The autopilot shall operate through parallel servos and be authority-limited mechanically.

### 7.4.1 Stability Augmentation System

A three-channel stability augmentation system having limited authority shall be provided for each of the roll, pitch, and yaw axes. The electronic units for each of the three channels ◊
of any axis shall be interchangeable. Electronic units of ◊
any axis shall not be interchangeable with those of another axis. A stability augmentation control panel shall be provided. It shall allow separate axis and channel selection and engagement.

Each control axis shall remain operational automatically after the first failure. Warning lights and test circuits shall enable the crew to identify and disengage manually a control channel in the event of further failures. No failure shall produce asymmetrical control moments in the roll axis.

7.4.2 Autopilot System

A dual-channel autopilot system shall be provided. The electronic units for each of the two channels of any axis shall be interchangeable. Electronic units of any axis will not be interchangeable with those of another axis. Monitors and limiting devices shall provide fail-safe operation.

The autopilot shall have the following modes of operation:

- Pitch axis:
  - Manual mode with control stick steering
  - Altitude capture
  - Altitude hold
  - Profile (climb and descent)
  - Glideslope with automatic capture
  - Glideslope with manual capture
  - Automatic landing
  - Go-around/takeoff
- Roll and yaw axes:
  - Manual mode with control stick steering
  - Heading select
  - En route navigation (inertial navigator) (VOR/LOC)
  - Wings level
- Auto thrust:
  - Calibrated airspeed select
  - Mach hold (with limited trim)

A flight mode selector panel shall be provided for autopilot and flight director engagement and mode selection. The panel shall be located directly above the pilots' center panel. Split-axis operation shall be possible by selective engagement of the autopilot axes.

The autopilot shall accept signals from the flight control and navigation integrated checkout systems. Self-contained test provisions shall also be provided within each of the autopilot control axes. Controls for selecting and initiating the test, and a suitable test indicator, shall be located on the front panel of each major component.

# 8.0 HYDRAULIC AND PNEUMATIC POWER SYSTEMS

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ILLUSTRATIONS

# 8.0 HYDRAULIC AND PNEUMATIC POWER SYSTEMS

## 8.1 HYDRAULIC POWER SYSTEM

### 8.1.1 System Description

The airplane shall be equipped with three completely independent hydraulic systems, identified as Systems A, B, and C. There shall be no interconnecting fluid paths between any of the three systems in the distribution or return lines, at the loads, or in the reservoir fill system. Fluid pressure shall originate from pumps mounted on each accessory drive gearbox (see Par. 5.11). Each system shall be designed for an operating pressure of 3000 psi with Humble ETO 5251 triester-base fluid. The system shall be capable of operating within a hydraulic fluid temperature range of -40 to +450°F. Fluid cooling shall be provided. A schematic diagram of the system is shown in Fig. 8-1.

### 8.1.2 System Function

The following functions shall be operated by all three hydraulic systems:

- Longitudinal flight control and trim system
- Directional flight control system
- Lateral flight control system
- Wing sweep
- Horizontal stabilizer trailing edges

Any one system shall be capable of providing sufficient power for control.

The following functions shall be operated by two hydraulic systems:

- Leading edge devices
- Trailing edge flaps

Either system shall be capable of providing sufficient power for control.

The following functions shall be operated by one hydraulic system:

- Main, nose, and tail landing gear extension and retraction (Manual landing gear extension system also provided, see Par. 4.5)
- Nose gear steering
- Main wheel brake system (Alternate system also provided, see Par. 8.1.19.1)

8.1.3 Hydraulic Pumps

8.1.3.1 System A Power

Fluid pressure for System A shall be supplied by two variable displacement pumps, one of which shall be mounted on the accessory drive gearbox driven by Engine No. 1, and one on the accessory drive gearbox driven by Engine No. 3.

8.1.3.2 System B Power

Fluid pressure for System B shall be supplied by two variable displacement pumps, one of which shall be mounted on the accessory drive gearbox driven by Engine No. 2, and one on the accessory drive gearbox driven by Engine No. 4.

8.1.3.3 System C Power

Fluid pressure for System C shall be supplied by two variable displacement pumps, one of which shall be mounted on the accessory drive gearbox driven by Engine No. 2, and one on the accessory drive gearbox driven by Engine No. 3.

8.1.3.4 Ground Checkout

For ground checkout, each hydraulic pump may be driven by an external pneumatic power source through its associated accessory drive gearbox.

8.1.4 Temperature Indication

A triple indicator coupled to a monitor switch shall be provided on the flight engineer's panel. The switch shall allow monitoring Systems A, B, and C for pump case drain and main system return temperatures. In addition, an overheat warning light shall be installed for Systems A, B, and C.

8.1.5 Hydraulic Fluid Tanks

Each system shall be supplied by its individual pressurized reservoir, designed in accordance with the requirements of MIL-R-8931. The alternate brake system shall be provided with a reservoir in the System C return line.

8.1.5.1 Fluid Level Indication

System A, B, and C reservoirs shall be equipped with fluid level transmitting devices. One fluid quantity indicator for each system shall be located on the flight engineer's panel, and one indicator for each system shall be provided at the pressure filling point. In addition, fluid quantity indication shall be provided at each reservoir.

8.1.5.2 Pressurization

System A, B, and C reservoirs shall be pressurized by engine bleed air pressure, reduced to a suitable level and applied to the fluid by a diaphragm.

8.1.5.3 Filling and Draining

Fluid reservoirs shall be pressure-filled through filters installed on the aircraft. Each hydraulic system may be readily drained and flushed.

8.1.6 Filters

Each hydraulic system shall be protected by disposable filter elements passing 25-micron absolute particle size for both the pressure and return sides, and by similar filters on the case drain line of each pump. Pressure and case drain filters shall be non-bypass-type. Bypass valves set at approximately 1000 psi shall be installed in the return line filters. All filters shall be equipped with temperature-compensated, clogged-element warning indicators.

8.1.7 Lines and Hoses

8.1.7.1 Rigid Tubing

Rigid tubing shall be fabricated of high strength, corrosion resistant metal. Lines shall be connected with welded or swaged fittings and shall be routed so that loosening or removal will be minimized for any maintenance operation.

8.1.7.2 Flexible Lines

Line flexibility shall be provided by tubing coils, swivel joints, or hoses, in this order of preference. Swivel joints or hoses shall be used only where dictated by envelope and motion requirements.

8.1.8 Component Attachment

In general, hydraulic system lines shall be attached to components with manifolds that are permanently connected to the fluid lines. Self-sealing connections shall be provided, where practical, to prevent fluid loss or entry of contamination during component removal for maintenance.

8.1.9 Seals

Dynamic external seals shall be two stage, with bleed between stages to return. Surfaces contacted by seals shall be chrome plated. Metal or plastic rings shall be used for actuator rod and piston seals. Static seals shall be Viton "O" rings supported by filled teflon backups. Carbon-faced seals shall be used in high speed rotary applications.

8.1.10 Pressure Indicators and Warning Lights

Remote-pressure-reading indicators shall be installed on the flight engineer's panel to provide pressure indication for each hydraulic system and for the landing gear brake system. Lights shall be provided adjacent to the pressure indicators to provide a caution indication when any pump output falls below a minimum value. A pressure gage shall also be installed adjacent to each accumulator charging connection. A pressure-drop warning indicator shall be installed in the passage between the elements of each two-stage seal to indicate abnormal leakage across the high pressure seals.

8.1.11 Fire Protection

Motor driven shutoff valves shall be installed in the engine driven pump supply lines and shall be controlled by switches located on the flight engineer's panel.

In the design of the hydraulic system, consideration shall be given to the location of components and lines to minimize potential fire hazards. The heat exchangers using fuel shall be located in the equipment bays described in Pars. 5.9.4 and 12.2.6.

8.1.12 Longitudinal Power Control

See Par. 7.2.1 for description of the longitudinal control system.

8.1.13 Lateral Power Control

See Par. 7.2.2 for a description of the lateral control system.

8.1.14 Directional Power Control

See Par. 7.2.3 for a description of the directional control system.

8.1.15 Wing Sweep

Hydraulic power from Systems A, B, and C shall operate the wing sweep differential drive mechanism. Each system shall be hydraulically independent and shall be individually capable of providing full hinge moment at one-third normal wing sweep rate. (See Par. 7.2.4 for a description of the wing sweep control system.)

8.1.16 Lift- and Drag-Increasing Devices

See Par. 7.3.1 for a description of the systems for the lift- and drag-increasing devices.

8.1.17 Landing Gear Operation

8.1.17.1 Power Source and Control

Power for extension and retraction of the main, nose, and tail landing gears; operation of the wheel well doors; nose wheel steering; and braking shall be provided by a single hydraulic system. A cable-operated, four-way control valve, positioned by a single control handle located on the pilots' main instrument panel, shall control landing gear position. A detent shall be provided in the control handle quadrant to retain the handle in the UP, OFF, or DOWN positions. Landing gear, brake, and retraction systems and the nose gear steering system shall be depressurized when the control handle is in the OFF position.

A gear extension alternate control handle shall control free-fall extension and locking of the nose and main landing gears.

8.1.17.2 Ground Safety

Movement of the normal landing gear lever to the UP position, except with the oleos fully extended, shall be prevented by a landing gear actuated locking device. The lock shall be automatically released when the oleo struts are fully extended and the nose gear is centered. A manual control shall be provided to override the landing gear actuated locking device.

8.1.17.3 Position Indication

The landing gear position indicators shall consist of:

- One landing gear door light (red)

- Four landing gear lights (red)
- Four landing gear lights (green)

The door light shall indicate when any door is not locked.

The red gear lights shall indicate:

- When the respective gear position is not consistent with the landing gear control lever position
- When gear is down but not locked
- When throttle settings are reduced in flight with the wings in the 20-degree-sweep position and the gear is not down and locked. The light will be extinguished when the manual silencer for aural warning is actuated.

The dimmable green gear lights shall be illuminated only when each respective gear is down and locked.

All landing gear lights shall be extinguished when the landing gear and doors are up and locked.

### 8.1.17.4 Landing Gear Doors

Landing gear doors shall be hydraulically operated through mechanically actuated sequence valves that cause the doors to open, then close, during normal gear extension or retraction. A door release system shall be provided for opening the landing gear doors from the ground. This release system shall position a three-way hydraulic valve, which will block the door-close line to prevent door retraction.

### 8.1.18 Nose Wheel Steering

Two double acting hydraulic cylinders shall be provided for nose wheel steering. Control shall be from a wheel mounted

on the captain's left sidewall, through a cable system, to a metering valve. Limited rudder pedal steering shall also be provided for taxi and takeoff. The hand wheel shall be capable of overriding rudder pedal steering.

8.1.19 Hydraulic Brake System

8.1.19.1 Hydraulic Power

Hydraulic power shall be available for normal braking of the main gears. Alternate hydraulic pressure for braking shall be supplied by an electric motor pump serving only the brakes. The brake system accumulator specified in Par. 8.1.19.5 and the pneumatic system specified in Par. 8.2 shall provide backup for the normal and alternate hydraulic brake pressure systems.

The main landing gear wheels shall be automatically braked before retraction.

8.1.19.2 Metering Valves

The hydraulic brakes shall be actuated by metering valves, controlled from the pilots' brake pedals.

8.1.19.3 Fuses

Quantity measuring fuses shall be provided for each brake to limit the loss of hydraulic fluid in the event of brake system failure downstream of the valve.

Self-sealing disconnect fittings shall be provided in the hydraulic lines between the brakes and the lockout valves to permit replacement of the brakes without system bleeding.

8.1.19.4 Antiskid System

A fully modulated antiskid braking system with individual wheel (two tires) control shall be provided for the main gear. Means shall be provided in the antiskid system to prevent wheels-locked landing. Antiskid shall be available from both normal and alternate hydraulic braking systems. ◊

8.1.19.5 Parking Brake

A mechanically controlled hydraulic parking brake shall be provided with control accessible to the pilots. The control shall indicate parking brake position.

A hydraulic system brake accumulator shall be installed to provide parking brake pressure. In addition, the accumulator shall be capable of providing five full brake applications during landing rollout (with the antiskid system off).

8.2 PNEUMATIC POWER SYSTEM

8.2.1 General

A standby pneumatic braking system shall be installed to provide power for wheel braking in the event of failures of both the normal and the alternate brake pressure systems (see Fig. 8-2). The system shall include a nitrogen cylinder, and a filler connection and pressure indicator shall be provided for ground servicing. In addition, a remote-reading pressure indicator shall be installed on the flight engineer's panel.

8.2.2 Brake Operation

The pneumatically powered standby brake system shall be capable of applying either partial or full braking. Pneumatic pressure shall be applied to the brakes through a fluid column extending from a transfer cylinder located in the nose wheel well. It shall not be necessary to bleed the hydraulic brake system after application of pneumatic pressure. Differential braking shall not be provided. The antiskid system shall not function with pneumatic braking.

8.2.3 Brake Control

Pneumatic braking shall be applied by actuating a control, accessible to both pilots, connected to a pressure modulating valve with pressure proportional to control handle movement. Brake release shall occur in not less than 3 seconds from release of full braking pressure.

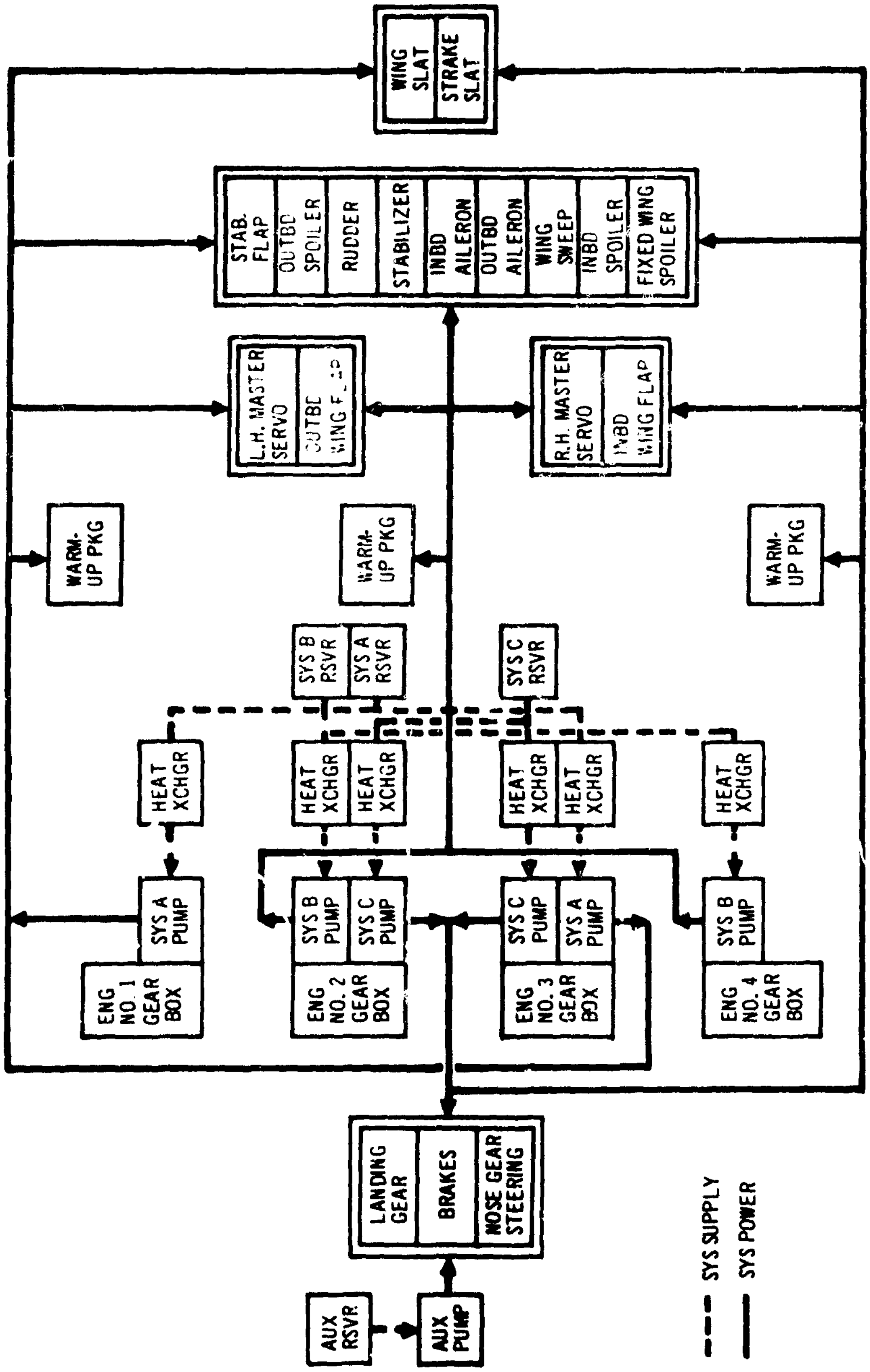


*Fig. 8-1 Hydraulic System Diagram*

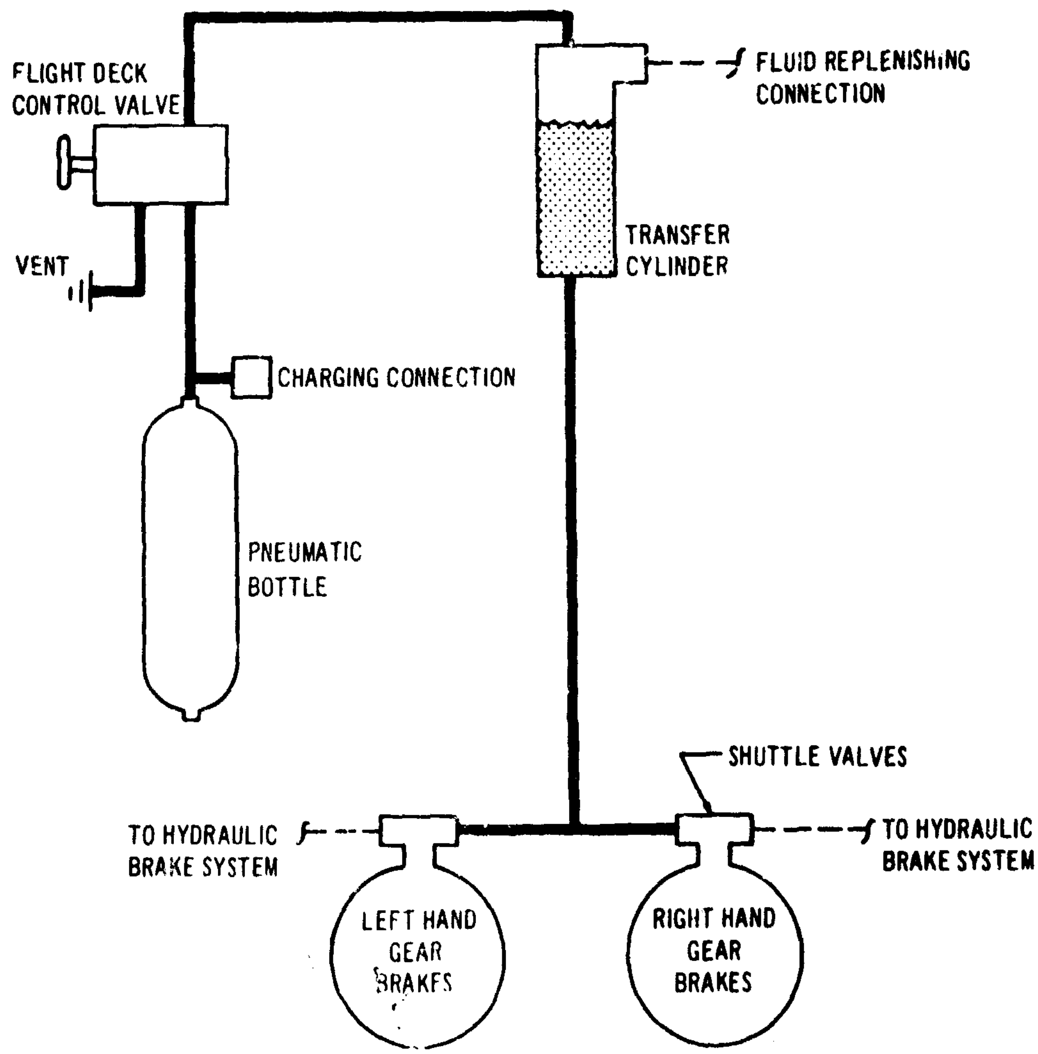


*Fig. 8–2 Pneumatic Brake System*

# 9.0 ELECTRIC POWER SYSTEM

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ILLUSTRATIONS

# 9.0 ELECTRIC POWER SYSTEM

9.1 GENERAL

The a.c. and d.c. power systems shall be substantially as shown in Figs. 9-1 and 9-2. The major components of the electrical system are listed in Appendix I.

9.2 WIRING

9.2.1 General

General airplane interconnecting wiring, shielded and unshielded, shall comply with applicable Boeing material specifications. Wiring shall be compatible with the electrical load requirements and the environment of the area in which it is installed.

Miniaturized plastic insulated wire or multiconductor cable may be used for interconnecting wiring, but shall be no smaller than Size 24 except where mechanical strength is not limiting. Individually shielded wire shall be used as needed in sensitive circuits to meet standard performance requirements.

The general requirements of ATA Specification 100, dated May 1, 1958, shall be used as a guide for the preparation and format of the airplane wiring diagram manuals.

9.2.2 Wire Protection

All load circuit wiring shall be protected by trip-free circuit breakers of suitable rating. Minimum circuit breaker ratings shall be chosen, consistent with no nuisance trips and current protection requirements. All a.c. and d.c.

circuit breaker controls shall be accessible to flight crew members during flight. The a.c. and d.c. circuit breakers essential to safe flight shall be accessible to flight crew members while seated at normal flight crew stations. Space shall be reserved on each circuit breaker panel for approximately 10 percent additional circuit breakers. Each circuit breaker, fuse, and limiter shall be placarded to indicate its rating and circuit function. The wiring diagram manuals shall show the same designations.

9.2.3 Design Practices

The AIA "Design Manual on Aircraft Electrical Installation" (June 1958) shall be considered as a guide generally defining acceptable industry practices for electrical installations, but it shall not preclude use of other types of installations providing equivalent or improved performance.

Wiring in raceways may be installed without bundle ties or conventional cable clamps. Special attention shall be given to protection of the wiring against mechanical damage, fatigue, fluid impingement, or local extreme environmental conditions.

Circuits that could create an emergency or hazardous condition, if operated inadvertently, shall be given special consideration in assembly, installation, and routing.

Electrical terminals, terminal strips, buses, or any open-type termination, shall be so installed as to minimize the probability of shock hazard or accidental shorting.

The major power controls (e.g., main circuit breakers, current transformers, voltage regulator, control panel, etc.) for each generator system shall be packaged in fire resistant, ATR-type modules.

Conduit shall be used where required to provide mechanical protection, reduce radio noise, or facilitate routing and maintenance in inaccessible areas. Conduit, when used, shall not be filled to more than 75 percent of its cross-sectional area.

Preinsulated crimp-type wire terminals shall be used except where environmental and safety considerations require use of other types of terminals.

Electrical connectors shall be crimped (solderless) removable-pin type, wherever practical.

Present commercial airplanes have experienced significant troubles with wiring installations in the exposed areas (wheel wells, wing trailing edge, etc.), limit switch applications, and mechanical and electromechanical switching methods. To minimize these potential problem areas and improve such factors as overall airplane safety, reliability, and usage, it is planned to include the following in design and fabrication of the airplane:

- Wiring and Connectors - In the selection and installation of electrical wiring and connectors, particularly in areas subject to extreme environmental conditions, special consideration shall be given to the choice of materials and installations to ensure improved performance, compared to present-day commercial airplanes.
- Switching - Solid-state switching shall be used in lieu of mechanical and electromechanical switching methods where an improvement in system reliability will result.

  Proximity switches shall be considered in lieu of mechanical switching methods for limit switch applications.

9.2.4 Component Identification and Terminal Marking

Each permanently installed junction box shall be identified, and durably numbered identification placards shall be installed on or adjacent to each terminal strip of two or more posts to identify each terminal. The terminal numbers shall be identical to those used on the wiring diagrams. Approximately 10 percent spare terminals or space provisions for additional terminals shall be provided in all multi-circuit junction boxes and terminal areas.

Discrete identification (equipment number as listed in wiring manual and component function description) shall be made by means of placards or other suitable markings adjacent to each component. Dymo tape and paper placards on junction box shield covers shall not be used. Junction box/unit hook-up wiring information shall be published in the Charts Section of the Wiring Manual.

Identification means shall be provided to ensure correct connections of cables and wires without reference to numbers or coding where the likelihood of incorrect connection otherwise exists.

Placards shall be installed at conspicuous locations on junction boxes, power shields, etc., to warn that danger of contact with high voltage exists.

## 9.3 GROUNDING, BONDING, AND ELECTROMAGNETIC INTERFERENCE

### 9.3.1 General

The intent of the grounding and bonding section of the AIA Design Manual shall be met by installing grounds and bonds generally in accordance with applicable Boeing process

specifications. These specifications shall reflect any ground return and bonding techniques that may be appropriate to configuration aspects peculiar to the Model 733 and to the predominant use of titanium instead of aluminum structures.

Use of common ground wires for more than one system or function shall be avoided except where design of the system requires or justifies such common use. Separate ground wires shall be used between units of a system when use of common ground returns could cause noise or malfunctioning because of circulating currents in the basic ground return system.

Normal operation of any electrical or electronic system or unit shall not cause malfunctions or undesirable response in any other system or unit. Undesirable response limits shall be as indicated below:

- Performance of receiving systems shall not be degraded by more than 4 db because of radio frequency interference.
- Undesirable noise (hum) shall be at least 40 db below the nominal audio signal output level. The nominal signal level for all modes of audio system operation, except passenger address, shall be taken as 1 volt across the headphone with a nominal impedance of 600 ohms. This corresponds to a maximum noise (hum) level of 10 millivolts across the headphone.
- The cross-talk interference level shall be at least 50 db below the audio signal level producing the cross-talk signal.
- Noise from short term transients exceeding the above limits shall not occur more than once in a period of 120 times the transient duration during normal operation.

Interference exceeding the preceding limits caused by Buyer-Furnished Equipment that does not meet the susceptibility or interference generation requirements of the applicable Boeing document cited in Par. 2.2.2 shall be the responsibility of the Buyer.

9.3.2 Static Dischargers

A means for controlling corona discharge interference resulting from precipitation or engine static charging shall be provided.

9.4 POWER SUPPLY

9.4.1 A.C. Power

The primary electrical system shall be a parallel, four-channel 115/200-volt, 3-phase, 400-cps, a.c. system with secondary provisions for isolated operation. One brushless, oil cooled generator rated at 40 kva shall be installed on each of the four accessory drive system gear boxes. The supervisory control system shall include automatic paralleling devices, protection devices, and logic circuitry as required for automatic system operation. Provisions for manual paralleling and for manual override of automatic supervisory controls shall be included as a secondary capability. Automatic system protection shall be provided against the following conditions:

- Overvoltage
- Undervoltage
- Overexcitation
- Underexcitation
- Overfrequency
- Underfrequency
- Differential Current

- Difference Current
- Exciter Ceiling

A load bus for each generator and a common system neutral shall be provided.

9.4.2 D.C. Power

The d.c. power shall be obtained from four 70-ampere, static, unregulated transformer-rectifier units installed in the electronic equipment area. The d.c. power system shall be substantially as shown on Fig. 9-2.

## 9.5 ELECTRICAL CONTROLS

The primary electrical system controls and indicators shall be installed on the flight engineer's panel.

## 9.6 STANDBY POWER

One 24-volt, nickel-cadmium battery shall be provided. A battery charger shall be installed.

Relaying shall be incorporated to prevent battery discharge through the normal d.c. bus. A battery control switch shall be provided on the flight engineer's panel. A static inverter capable of supplying all a.c. loads required for limited subsonic flight and emergency communications/navigation shall be installed as a standby source for a.c. The static inverter shall be capable of continuous operation without forced cooling.

The following items shall be energized from the "hot" battery bus:

- Battery Bus
- Battery Control Relay

- Generator Control
- Interphone
- Fueling Service Light
- Fueling Valves

## 9.7 ESSENTIAL POWER

### 9.7.1 General

Essential a.c. and d.c. power shall be provided to supply power to selected loads.

The essential a.c. bus shall supply the following functions:

- Essential Transformer-Rectifier Unit
- Essential a.c. Electronics Bus supplying the following functions:
    - Autopilot
    - Stability Augmentation System No. 1
    - H.F. No. 1
    - Air Data System No. 1
    - Integrated Flight Instrument System No. 1
    - Weather Radar
    - Radio Altimeter No. 1
    - ADF No. 1
    - VOR/LOC/G.S. No. 1
    - DME No. 1
    - Marker Beacon
- Landing Lights
- Passenger Warning Signs
- Battery Charger
- 115-volt a.c. Inverter Bus supplying the following functions:
    - Fire Detection Systems
    - Captain's Pitot Heater
    - Engine Ignition (only one engine at a time)

- 115-volt a.c. Emergency Electronics Bus supplying the following functions:
  - Integrated Flight Instrument System No. 1
  - Inertial System No. 1
  - Air Data System No. 1

The battery bus shall supply the following functions:

- Fire Extinguishing System
- Standby Inverter
- Fuel Shutoff Valves
- Fuel Crossfeed Valves
- Essential a.c. Bus Failure Light
- Warning Horn
- Emergency Flight Deck Lights
- Emergency Exit Lights
- Emergency d.c. Electronics Bus supplying the following functions:
  - Flight Recorder
  - VHF No. 1
  - Voice Recorder
  - Passenger Address
  - Inertial System No. 1
  - Integrated Flight Instrument System No. 1

9.7.2 Essential Power Selection

An essential a.c. power selector switch, located on the flight engineer's instrument panel, in conjunction with associated control circuitry, shall provide for manual control of relays to transfer to an available alternate generator during power interruptions on the essential bus.

A warning light, installed near the essential a.c. power selector switch, shall indicate loss of power at the essential a.c. bus. The selector switch shall be detented

for normal setting from generator number one main bus (see Fig. 9-1).

9.8 EXTERNAL POWER

An external a.c./d.c. power receptacle shall be provided near the main power distribution center. A light located on the flight engineer's panel shall indicate when external power is connected. The aircraft electrical system shall include protection from overvoltage, reverse phase rotation, and open phase voltage of the external power source. Airplane systems shall function satisfactorily when the electrical power delivered at the external power receptacle is within the voltage and frequency limits specified in Par. 9.9.

Means shall be provided to connect external power to the principal interior lights, position lights, and convenience outlets (see Par. 9.12), without energizing the balance of the airplane power distribution system.

9.9 POWER SYSTEM - VOLTAGE AND FREQUENCY

Power system nominal voltages and frequencies at the main buses shall be as follows:

| | Voltage | Frequencies (cps) |
|---|---|---|
| A.C. Bus (Airplane System) | 115 + 4.5, - 3.5 | 400 ± 5 |
| A.C. Bus (Ground External Power Operation) | 115 + 4.5, - 3.5 | 400 ± 10 |
| D.C. Bus | 27 + 2.5, - 2.5 | |

9.10 EQUIPMENT INSTALLATION

Equipment shall be selected and installed with due regard to operating conditions to which it may normally be subjected. Forced air cooling shall be provided for equipment units that require cooling for normal service life. Wherever practicable, installation shall permit ready inspection, access, and replacement without removal of other equipment. Electrical equipment installations shall be identified by suitable markings.

9.11 LIGHTING

9.11.1 General

All lighting shall be powered by a.c. power except for the emergency lighting, which shall use self-contained batteries. Bulb replacement shall be possible with common hand tools. Spare bulb stowage shall be provided. Single-contact bulbs shall be used wherever practicable.

9.11.2 Flight Deck Area Lighting

All instruments in the flight deck area shall be white integrally lighted, and all panel lightplates shall be white lighted. White background lighting shall be provided for the pilots' main and overhead panels and the flight engineer's panel. Red and white floodlighting shall be provided for the control stand and general flight deck areas. In general, the lighting shall be in conformance with SAE Aeronautical Standard Practice 264D.

9.11.3 Passenger Cabin Lighting

A reading light shall be provided for each passenger seat with its switch adjacent to the light. The design shall permit adjustment of the reading light for optimum position.

Main cabin general illumination shall be provided by incandescent lights. Controls for the cabin lights shall be on the attendants' panel.

Lavatories shall be illuminated by mirror lights. When not in use, the lavatories shall be illuminated by a low intensity bulb. Upon actuation of the sliding door lock, the mirror light shall illuminate. Means shall be provided to energize all lavatory lights for maintenance purposes.

Each galley shall have lights to illuminate the working area. The lights shall be of the variable intensity type and shall control light intensity from OFF through DIM to BRIGHT. The switches shall be located in the vicinity of the galleys.

Each main entry doorway shall be provided with a light suitable for checking passenger lists and a door threshold light, both controlled by a switch on the respective attendants' control panel. The entry area lights shall be operable when power is connected to the external power receptacle, regardless of the position of the external power control switch on the flight engineer's panel.

NO SMOKING and FASTEN SEAT BELT signs shall be installed in view of the passengers. A RETURN TO SEAT sign shall be installed in each lavatory. OCCUPIED indication signs shall be provided for the lavatories. The appropriate sign shall be visible to each passenger. A switch for the NO SMOKING and a switch for the FASTEN SEAT BELT and RETURN TO SEAT

signs shall be located on the pilots' overhead panel. In addition to the signs, these switches shall actuate a chime, audible to the cabin attendants.

9.11.4 Emergency Lighting System

An emergency lighting system shall be provided consisting of one light assembly in the flight deck area, one light assembly in the electronics compartment aisle, one light assembly at each emergency exit, one light assembly at each main entry and galley service door, and one light assembly in the forward and aft main cabin ceilings. Each assembly shall consist of a lamp, control relays, and nickel-cadmium battery of approximately 1 ampere hour capacity. At the exits, the lights shall illuminate the cabin interior adjacent to the exit. Illumination of the wing upper surface, adjacent to the overwing exit hatches shall be provided by the emergency lighting system. A master control switch, providing ON, ARMED, and OFF switch positions, shall be located on the pilots' overhead panel. An indicator light adjacent to the switch shall illuminate whenever the switch is not in the ARMED position. Trickle charging from the d.c. essential bus shall be provided for all batteries. The light assembly shall be capable of being turned off and on when removed from its normal installed position for use as a portable light.

With the master switch in the ARMED position, loss of airplane a.c. essential bus power shall automatically illuminate all emergency lights. With the master switch in the ON position, all emergency lights shall be illuminated. Each emergency light assembly installation shall be designed to withstand up to 20g crash loads. ◊

9.11.5 Electrical, Electronic, and Cargo Compartment Lights

Electrical, electronic, and cargo compartments shall have lights for illumination of equipment and cargo. Control of the lights shall be located adjacent to the compartment entry doors and alsc adjacent to the viewing windows for the lower cargo compartment.

The cargo compartment lights shall be shielded against damage by cargo and shall be chosen and located to minimize the possibility of charring cargo. The cargo compartment lights shall provide sufficient illumination outside of each cargo compartment door to allow reading of baggage tags and identification of cargo at a distance of 25 feet from the door opening.

9.11.6 Equipment Area Lighting

Lights shall be provided for illumination of the wheel wells, air conditioning and accessory power compartments, major junction boxes, ground fueling panel, and aft body interior. Switches for the compartment lights shall be located within the compartment. Switches for the major junction box lights shall be located adjacent to the boxes.

9.11.7 Exterior Lighting

The landing light installation shall consist of a minimum of two 1000-watt lights. The lights shall be controlled by individual switches located on the pilots' overhead panel.

Navigation lights shall be provided and shall give coverage in accordance with Federal Air Regulations, regardless of wing position.

High intensity anticollision lights shall be provided.

Runway turnoff-taxi lights shall be installed with separate control switches located on the pilots' overhead panel.

Lights shall be installed in the side of the fuselage to illuminate the wing leading edge. These lights shall also provide illumination to assist in ground service of the airplane. Control shall be on the pilots' overhead panel.

## 9.12 SERVICE OUTLETS

The galleys shall be serviced by a total of 36 kilowatts of 3-phase, 400-cps, 115/200-volt a.c. power. This service shall be controlled by a switch at the flight engineer's station.

Each lavatory shall be provided with one 115-volt d.c. and one 28-volt d.c. razor outlet.

Outlets, providing 115 volts of 400-cps a.c. power, shall be installed at the electrical and electronic equipment racks and in the flight deck area for test equipment. Four convenience outlets each capable of supplying 1000 watts of 115-volt, 400-cps power shall be provided in the passenger cabin.

## 9.13 CALL SYSTEM

### 9.13.1 Attendants'

An attendants' call system shall be installed and shall operate as follows:

Master call annunciator light fixtures shall be installed in the main passenger cabin. Separate colored lights shall indicate calls from the flight crew or attendants, the lavatories, or the passenger cabin. Call buttons shall be installed in each lavatory, in the flight deck area, and on each passenger service unit. Operation of the passenger call system button shall illuminate a light at the seat and the applicable master light and shall sound a tone through the passenger address system. Resetting the passenger service unit light shall be accomplished at the unit. The master light shall extinguish when all seat lights have been reset. Lavatory call lights shall be reset at the respective attendants' forward or aft control panels. The flight-crew-to-attendant call shall illuminate the applicable master call light and sound the tone through the passenger address system. A call button shall be provided at each attendants' station that shall operate a single-stroke tone and light in the flight deck area. A second call button shall be provided at each attendants' station for calling between attendants' stations. This button shall operate the same circuit as the flight-crew-to-attendant call.

Call light circuitry shall be adjustable so that calls originating ahead of the variable location class divider partition shall register at the forward annunciator light, and calls originating aft of the partition shall register at the aft annunciator light.

9.13.2 Ground Crew

A horn shall be installed in the nose wheel well to enable the flight crew to call a ground crewman to the interphone. The control for the horn shall be accessible to the pilots.

## 9.14 WARNING INDICATORS

### 9.14.1 Aural Takeoff and Landing

An aural warning device in the flight deck area, audible to the flight crew, shall warn against:

- Takeoff with the outboard wings, flaps, horizontal stabilizer, or spoilers in improper positions.
- Landing with the landing gear in other than the down position when the throttle settings are reduced and the wings are at the 20-degree sweep position. A manual silencer shall be provided for a warning caused by retarding of the throttles.
- Landing with the landing gear in other than the down position when the wing flaps are extended to the recommended position for landing. A landing gear warning initiated by flap position shall be silenced by extending the landing gear or retracting the flaps.

### 9.14.2 Mach and Airspeed Warning

An aural warning, distinctly different from all other warnings, shall be installed to indicate when Mach or airspeed placard limits are exceeded.

### 9.14.3 Cabin Altitude Warning

An audible warning device shall provide automatic warning if the cabin altitude exceeds a nominal 10,000 feet. It may be silenced by a switch on the cabin pressure control panel, and shall automatically reset when the cabin altitude returns below the warning altitude.

9.14.4 Fire and Overheat Warning

Each engine and each equipment bay containing fuel heat exchangers shall be provided with a fire detection and control system. In addition, each main wheel well shall be provided with an overheat detector system. Activation of any of the detector systems shall energize a warning bell and illuminate a master fire light and the appropriate individual fire area identification light on the captain's panel and the appropriate fire warning light in the handle of the fire switch on the pilots' overhead panel. The warning bell and lights shall be activated when a detection circuit is tested. A push button switch shall be installed adjacent to the warning lights; this switch shall silence the warning bell and automatically reset the circuitry so that the bell will sound again on the next warning.

9.14.5 Master Warning Light

A master warning light shall be installed on the pilots' main panel. The light shall emit a flashing signal whenever a systems warning light is illuminated on the flight engineer's instrument panel. It shall be a push-to-reset type. Resetting shall extinguish the light and arm the circuitry for a succeeding warning light signal from the flight engineer's panel.

9.15 FIRE SWITCHES

9.15.1 Engine

A fire switch for each engine, accessible to the pilots and the flight engineer, shall be provided on the pilots' overhead panel. Actuation of the switch shall accomplish the following functions:

- Close engine fuel shutoff valve
- Arm engine fire extinguishing system
- Close engine air bleed shutoff valves
- Close engine anti-ice valve
- Close the secondary air supply doors.

9.15.2 Equipment Bays Containing Fuel Heat Exchangers

Actuation of equipment bay fire switches shall:

- Bypass fuel around fuel-cooled heat exchangers
- Shut off cabin air from the cabin air heat exchangers
- Close hydraulic pump supply and shutoff valves.

9.16 NOSE SECTION ACTUATION

The movable nose section shall be operated from the flight deck by a motor-driven screw-type actuator capable of modulation to provide intermediate positions. A means of manual actuation shall also be provided on the flight deck.

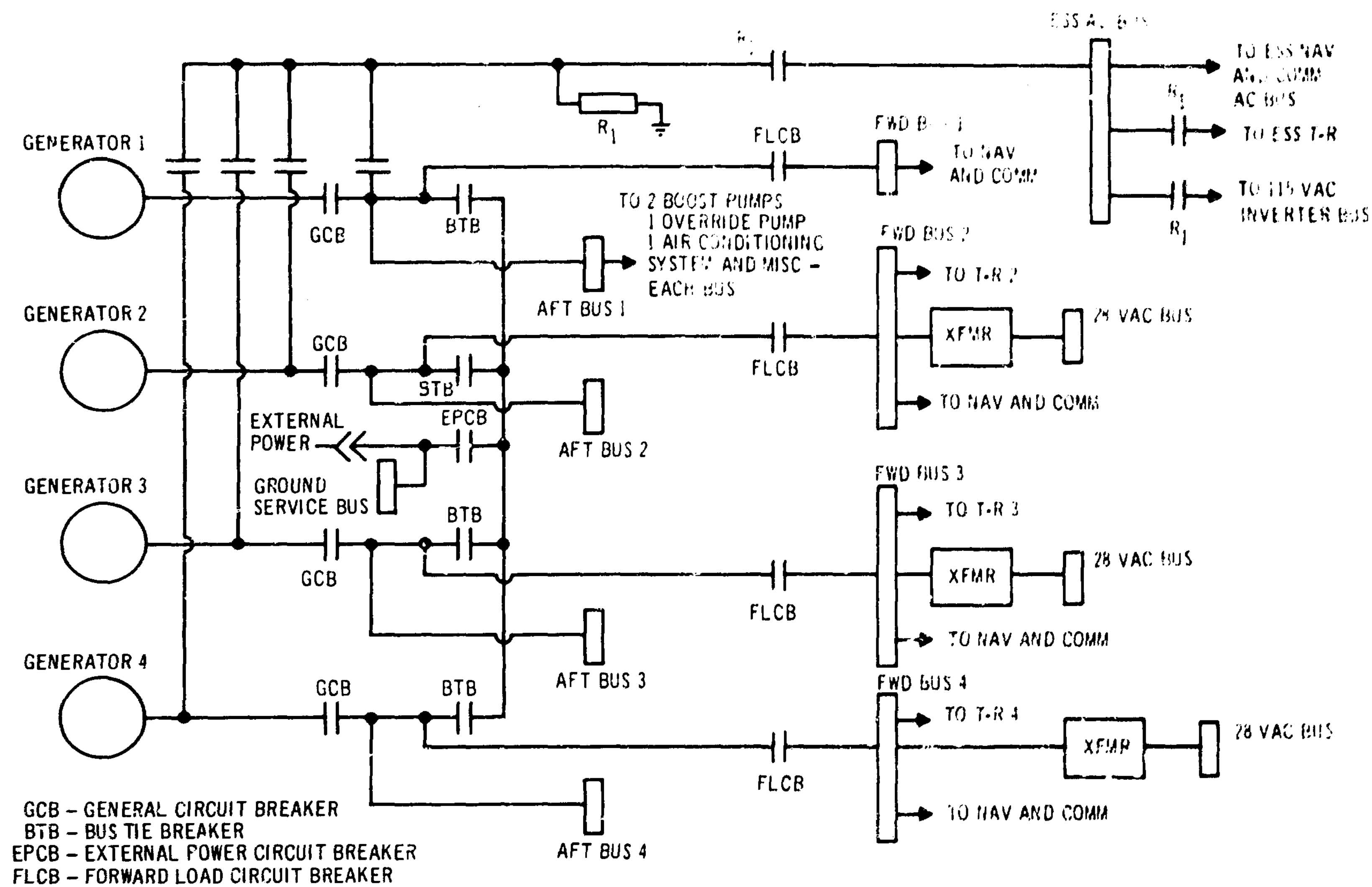



*Fig. 9–1 A.C. Power System*

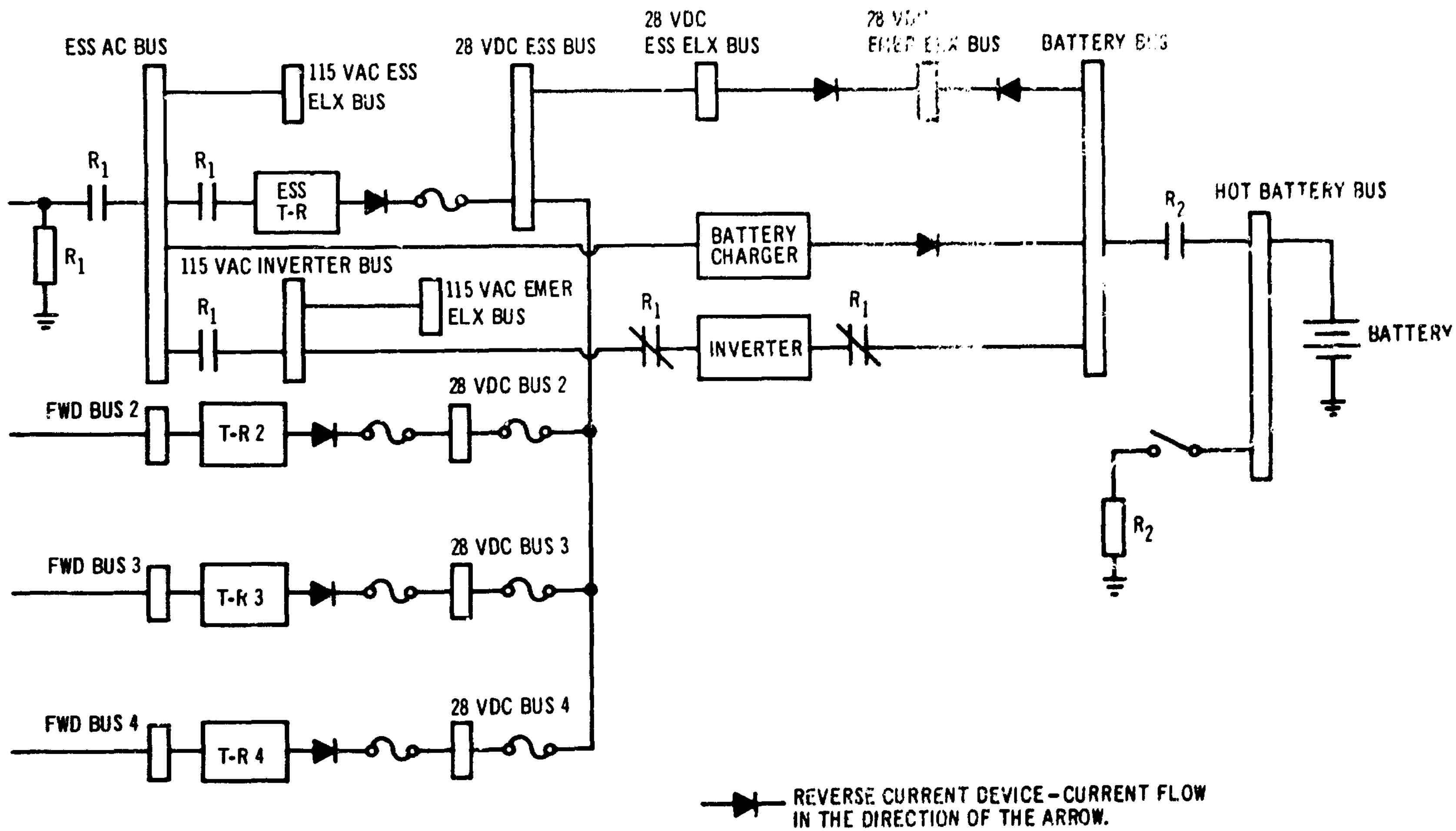



*Fig. 9–2 Essential A.C. Bus D.C. Power System*

# 10.0 AVIONICS

CONTENTS



ILLUSTRATIONS

# 10.0 AVIONICS

10.1 GENERAL

10.1.1 Installation

The radio and electronics equipment listed in Appendix I and the systems as defined herein shall be provided. All miscellaneous electronic components (e.g., resistors, relays, diodes, etc.) required to adapt the electronics systems to the aircraft shall be installed in related ATR-type boxes.

Each antenna assembly (having the same part number), except those such as the ADF sense and HF communications antennas, which are integral with the structure, shall be interchangeable between aircraft. (See Par. 14.2.1.) ◊

10.1.2 Grounding, Bonding, and Electromagnetic Interference

See Par. 9.3.

10.1.3 Wiring

See Par. 9.2 for general wiring installation requirements. Except where specified elsewhere in this Specification, removable end segments shall be provided on all coaxial cable lead-ins, where it is difficult to replace the entire cable. ◊

Coaxial cables associated with receiving or transmitting equipment shall either be connected to the front of the unit or have an in-line connector in the vicinity of the unit easily accessible for testing and measurement purposes. Circuits that are critical performancewise may be an exception. ◊

To facilitate maintenance and modification of electronic equipment, intertie wiring shall be located in plug-in-type interface boxes.

10.1.4 Power Control

Two master radio power switches shall be located in the flight deck area, accessible to the pilots.

10.1.5 Equipment Racks

The main equipment racks shall be located in the upper section of the fuselage, between the passenger and flight deck compartments. An additional equipment rack shall be provided in the aft cargo compartment, separated and protected from the cargo area. If required, forced air flow shall be provided, on the ground and in flight, to cool equipment and remove smoke that could result from possible equipment malfunction.

10.2 EN ROUTE NAVIGATION SYSTEM

10.2.1 Inertial System

Three inertial navigation systems shall be installed to perform the following functions:

- Guidance information for either manual or autopilot coupled control of the airplane along a predetermined course
- Navigation data for en route reporting and flight schedule evaluation through the HF communications systems and satellite communications systems when available
- Attitude and directional references for the flight and navigation instrument systems
- Weather radar antenna stabilization

Navigation display outputs, selectable by the navigation display panel, shall include:

- Present position latitude and longitude
- Destination latitude and longitude
- Desired track angle and cross-track distance
- Ground speed and track angle
- Distance and time to destination

The inertial navigation equipment shall be installed in the electronics equipment area. The control, display, and data insert panels shall be installed in the flight deck area, accessible and visible to the pilots.

The magnetic azimuth detectors and compensators shall be interconnected to the inertial systems. Inertial heading shall be used to damp the unstabilized magnetic heading signal. The controls for both magnetic and inertial compass systems shall be included in the inertial navigation control panels.

10.2.2 Weather Radar System

A weather radar system shall be installed and shall provide a normal direct-view bright-tube video display of weather targets and rainfall gradient (iso-echo contour map) display. The system shall be optimized for weather turbulence detection. The ground mapping features and display shall be considered a secondary benefit. The radar antenna shall be installed in the nose of the radome. The antenna shall be stabilized by roll and pitch attitude signals from an inertial navigation system. A receiver/transmitter shall be installed in a pressurized area as close as possible to the antenna. One control unit and two display indicators shall be provided.

A bidirectional coupler shall be installed in the waveguide adjacent to the receiver/transmitter unit. Easy access shall be provided for use of the reflectometer for maintenance purposes.

The structure of the radome shall have adequate drainage provisions to prevent entrapment of moisture.

The average one-way power transmission of the radome shall not be less than 90 percent, and the minimum transmissivity at any given point should be not less than 85 percent throughout the window area. The window area is that portion of the radome through which the main lobe of energy must be transmitted as the antenna is tilted and rotated to all mechanical limits.

Power reflected back into the radar system by the radome should be less than 0.5 percent of the impinging energy at all positions of the antenna within its mechanical limits.

No side lobe shall be changed more than plus 3 db by the presence of the radome and associated structure and no side lobe shall exceed the level of minus 18 db with respect to the main beam.

The radar and components attached to and within the radome shall be adequately protected against damage due to lightning and static discharge. Radome lightning diverter devices shall be capable of handling high energy lightning strikes and shall be capable of being grounded in a positive manner. The ground path shall have the capacity of handling the attendant high current discharges. The devices shall not be seriously

damaged other than discoloration and/or pitting by a lightning stroke current defined as follows:

- Initial component of current increasing to 200,000 amps in 5 microseconds and decaying to 50,000 amps in 10 microseconds, followed immediately by
- A second component of current increasing to 2000 amps within 5 milliseconds and a total charge transfer of 30 coulombs, and followed immediately by
- A third component of current of 500 coulombs charge transfer in 2 seconds or less.

10.2.3 LORAN

Space provisions for a LORAN system installation shall be provided in the electronics equipment and flight deck area. The No. 2 HF communications receiving antenna may be used as a LORAN antenna.

10.3 FLIGHT INSTRUMENTATION

10.3.1 Integrated Flight Instrument Systems

Dual integrated flight instrument systems shall be installed.

Attitude director indicators (ADI's) and horizontal situation indicators (HSI's) shall be installed on the pilots' main instrument panel. The ADI's shall be equipped with a comparator discrepancy warning light and shall display:

- Airplane attitude
- Attitude and speed commands
- Glide slope and localizer deviation
- Radio altitude.

The HSI's shall display:

- Selected heading
- Magnetic heading
- VOR/LOC deviation
- Radio bearing
- Distance to DME station and glide slope deviation during terminal area operation
- True heading
- Desired track angle
- Cross-track deviation during en route operation.

A third attitude heading display instrument, installed on the pilots' main panel, shall display attitude and heading information from the third inertial navigation system.

A flight director computer, combined with the autopilot computer, shall be installed in the electronic equipment area and shall provide a roll and pitch channel and perform the attitude command computations for manual flight. The autopilot flight reference selector shall be the source of mode selection. Modes shall be provided for:

- Takeoff and go-around
- Climb
- En route navigation
- Descent
- Terminal navigation
- Low approach
- All-weather landing including flare and touchdown.

An approach progress annunciator shall be installed on the pilots' main instrument panel. The annunciator shall visually confirm system mode changes during:

- Approach and landing
- Marker beacon indications
- Minimum radio altitude warnings.

Two combination radio altimeter/vertical speed indicators shall be installed on the pilots' main instrument panel and shall display:

- Radio altitude
- Vertical speed
- Selected minimum altitude.

A comparator warning and approach gate monitor shall be installed. The comparator shall automatically cross check essential instruments and warn the crew of any discrepancy in compared parameters. During ILS approaches, the approach gate monitor shall warn the crew if the aircraft exceeds the boundaries of a pre-established "gate" or "window" through which a safe landing can normally be accomplished.

An attitude warning system shall advise of tail wheel contact during takeoff ground roll and warn of excessive angle of attack during all flight regimes. The altitude warning system shall be composed of body-mounted, angle-of-attack sensors, control unit, control stick shakers, and flap position transducers.

10.3.2 Air Data System

Dual air data systems shall be installed. The air data computers shall be located in the electronic equipment area and receive pitot and static pressures from the pitot-static system described in Par. 6.6. Space shall be reserved in the electronic equipment area for a third air data computer. Dual total temperature probes shall be installed.

The following air data displays shall be installed on the pilots' main instrument panel:

- Pressure altitude
- Calibrated airspeed
- Indicated airspeed

- Mach number
- Total air temperature.

The pressure altitude and calibrated and indicated airspeed indicators shall be of the servopneumatic type.

A single display of static air temperature and true airspeed shall be installed on the pilots' main panel.

10.3.3 Radio Altimeter

Dual low range radio altimeter systems shall be installed to provide accurate height data during approach and landings. Transmitting and receiving antennas shall be installed on the bottom body centerline as shown in Fig. 10-1. Radio altitude shall be displayed on the pilots' ADI's and radio altitude and vertical speed indicators.

10.4 TERMINAL NAVIGATION SYSTEM

10.4.1 Automatic Direction Finding Systems (ADF)

Dual ADF systems shall be installed. Each system shall consist of a loop antenna, sense antenna, receiver, and control panel. The control panels shall be installed in the flight deck area, accessible and visible to the pilots. ADF bearing from each system shall be selectable on both pilots HSI's.

10.4.2 VOR/LOC/Glide Slope

Two VOR/LOC/glide slope systems shall be installed. Dual receivers shall be installed in the electronic equipment area. The VOR/LOC antennas shall be installed as shown in Fig. 10-1. A dual feed glide slope antenna shall be installed as shown in Fig. 10-1. The VHF NAV-1/VHF COMM-1 control panel shall be installed on left side of the glare shield

and the VHF NAV-2/VHF COMM-2 control panel shall be installed on the right side. Both units shall provide control of the companion glide slope receiver and DME interrogator. Instrumentation output and instrumentation control circuits from VHF navigation receivers and glide slope receivers shall be connected to the appropriate navigation indicators located on the instrument panels through the applicable switching circuitry specified in Par. 10.3.1. VOR bearing shall be selectable on both pilots' HSI's. The following shall apply when the deviation selectors are in the VOR/LOC position:

- VOR deviation and TO-FROM information shall be displayed on the HSI's when VOR frequencies are selected
- Localizer deviation shall be displayed on the HSI's and ADI's
- Glide slope deviation shall be displayed on the HSI's when localizer frequencies are selected.

10.4.3 Distance Measuring Equipment

Two DME systems shall be installed. The transmitter-receiver shall be installed in the electronic equipment area, and the antennas shall be installed as shown in Fig. 10-1. Distance information shall be displayed on the HSI's located on the pilots' main instrument panel. DME control and channel selection shall be provided on the VHF control panels described in Par. 10.4.2.

10.4.4 Marker Beacon

A marker beacon system shall be installed. The receiver shall be installed in the electronics equipment area. The antenna shall be installed as shown in Fig. 10-1. Over-the-station indication shall be provided visually and aurally.

## 10.5 SHORT RANGE COMMUNICATION SYSTEM

### 10.5.1 VHF Communications

Dual VHF communications systems shall be installed. The VHF transceivers shall be located in the electronics equipment area. Two VHF blade antennas shall be installed as shown in Fig. 10-1. Controls for the VHF communication systems shall be provided on the VHF control panel as described in Par. 10.4.2.

### 10.5.2 ATC Transponder

Dual ATC transponder systems shall be installed. The two transponders shall be located in the electronics equipment area. Two flush antennas shall be installed as shown in Fig. 10-1. A dual system control panel shall be installed in the flight deck area accessible to both pilots. Pressure altitude information for altitude reporting shall be provided to the ATC transponders from the air data system.

### 10.5.3 Interphone System

Flight and service interphone systems shall be installed.

The flight interphone section of the system shall provide for communication between the flight crew and cabin attendants.

The service interphone section of the system shall provide for communication between:

- Flight deck
- Cabin attendants' stations
- Electronics equipment area

- Nose wheel well
- Fueling stations

A two-position toggle switch shall be installed on the flight engineer's panel to disconnect the service section of the interphone from the flight section.

Audio selector panels shall be located at the captain's, first officer's, flight engineer's, and forward observer's stations.

Interphone panels shall be located at the cabin attendants' stations, electronics equipment area, nose wheel well, and fueling station.

The interphone amplifier shall be located in the electronics equipment area.

Handsets shall be installed at the forward and aft cabin attendant's stations and in the flight deck area.

Headphones, boom microphones, oxygen mask microphones, and stowage provisions shall be installed at the captain's, first officer's, flight engineer's, and first observer's stations. Microphone selector switches shall be provided.

Two-position, push-to-talk switches for interphone and air-to-ground communications shall be installed on the outboard horns of the pilots' control sticks and on the side panels. A MAINTAINED position shall be provided on each switch to permit interphone communication to be maintained without the necessity for the pilot's hand to remain on the switch. Push-to-talk switches shall be provided at the flight engineer's and first observer's stations.

Loudspeakers, audible at the pilots' seated positions shall be installed in the flight deck area. (See Par. 10.5.4.)

10.5.4 Passenger Address System

A passenger address system shall be installed to provide voice and music reproduction in the passenger cabin.

Transistorized noise cancelling microphones shall be installed at the cabin attendants' stations. The pilots shall have priority over the cabin attendants in the use of the passenger address system. A switch controlling priority between the cabin attendants shall be installed on the forward attendants' panel.

Loudspeakers in the passenger cabin shall be located as necessary to provide essentially uniform sound distribution. Supplementary loud speakers shall be installed in each lavatory. Cabin-attendant-initiated passenger address system announcements may be monitored by the flight crew through the interphone loudspeakers. (See Par. 10.5.3.)

10.5.5 Flight Data Recorder System

A flight recorder system shall be provided. The recorder unit shall be installed in the aft cargo area. A normal accelerometer shall be installed near the airplane center of gravity. Minimum data recorded shall be pressure altitude, indicated airspeed, magnetic heading, normal acceleration, and time.

An encoder panel shall be installed at the flight engineer's station. A test switch and indicator light shall be located in the flight deck area. Power to the flight recorder shall be available from airplane power or, through the test switch, from external power.

10.5.6 Flight Deck Voice Recorder

A flight deck voice recorder unit shall be installed in the aft cargo area. A microphone panel and a control panel shall be installed, accessible to the pilots and flight engineer respectively.

10.6 LONG RANGE COMMUNICATION SYSTEM

10.6.1 HF Communications

Dual HF communication systems shall be installed. The two transceivers and coupler controls shall be located in the electronics equipment area. The antenna couplers and transfer switch shall be installed in the aft equipment racks. The No. 1 HF antenna shall provide the transmit antenna function for the No. 1 and 2 HF communication systems and the receive function for No. 1 HF. The No. 2 HF antenna shall provide the receive-only function for the No. 2 HF system. The dual control panel shall be located in the flight deck area, accessible to both pilots.

10.6.2 Selective Calling System

A dual channel selective calling system (SELCAL) shall provide visual and aural alerting indication when receiving properly coded HF and VHF communications. The decoder ◊ shall be installed in or adjacent to the cockpit area so that the code selector controls are readily accessible without removing the equipment from its mounting rack. The ◊ control panel shall be located in the flight deck area, accessible to the pilots. The control panel shall permit ◊ pilot selection of the SELCAL inputs to either channel from any of the HF or VHF communications equipments (2 HF and 2 VHF receivers).

The receiver outputs shall not be attenuated between the receiver outputs and the SELCAL input. A correctly coded SELCAL signal shall actuate a continuous chime and light (one light for each SELCAL channel). Each SELCAL channel shall be resetable by depressing its indicator light. One SELCAL placard shall be installed as near as practicable to the SELCAL unit in the equipment rack. A second SELCAL placard shall be installed in the cockpit readily visible to both pilots. Both placards shall include the airplane serial number, the FAA registration number, and the airplane SELCAL code.

## 10.7 FLIGHT CONTROL AND NAVIGATION INTEGRATED CHECKOUT SYSTEM

In-line monitoring and checkout provisions shall be included where practical in the individual systems.

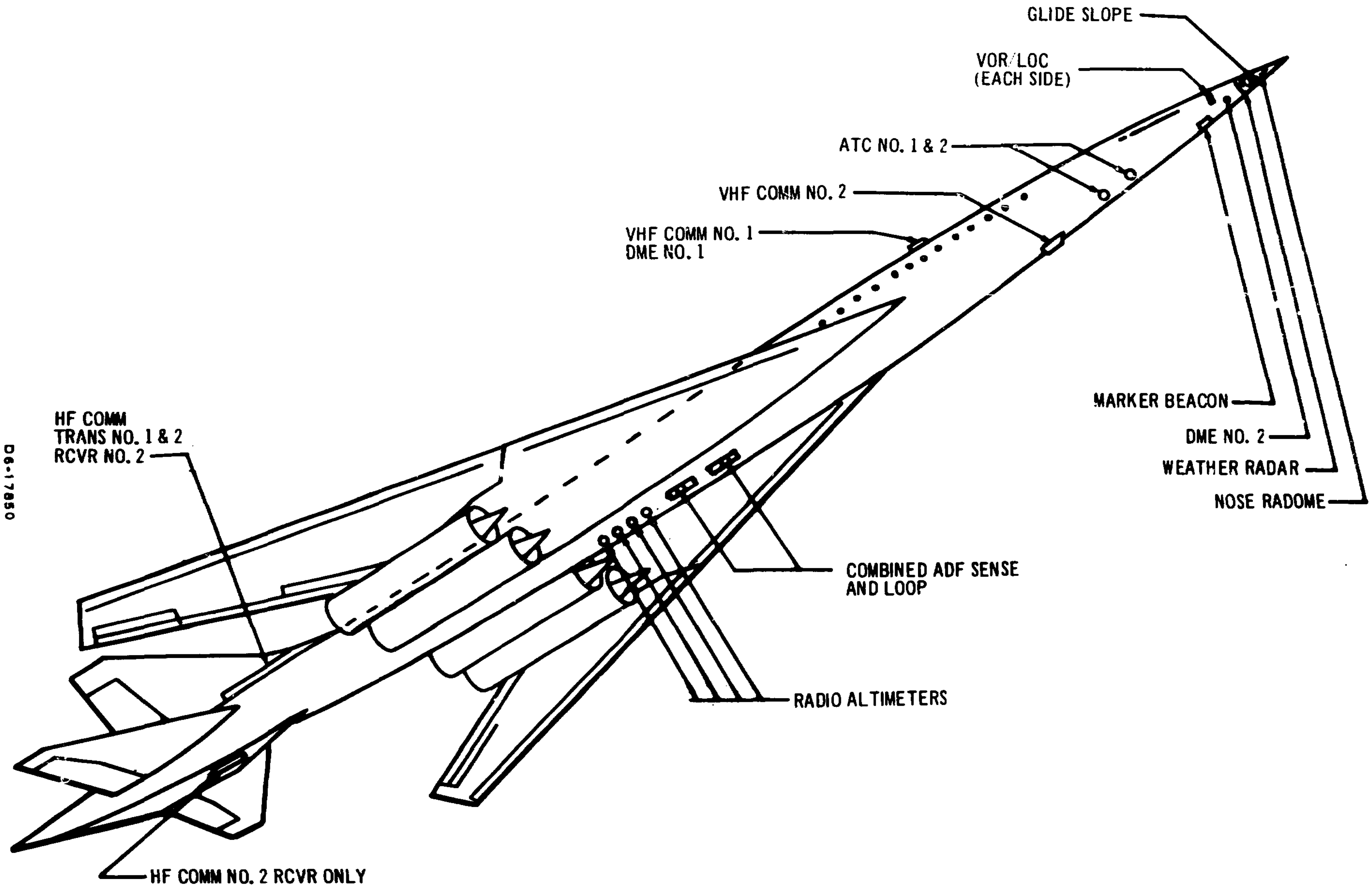



*Fig. 10–1 Antenna Locations*

# 11.0 PASSENGER AND CARGO PROVISIONS

CONTENTS

## CONTENTS (Continued)



## ILLUSTRATIONS

# 11.0 PASSENGER AND CARGO PROVISIONS

11.1 GENERAL

The passenger cabin arrangement shall be substantially as shown in Fig. 11-1. For drainage and ventilation information, see Par. 4.1.4.

11.1.1 Interior Finishes and Colors

Detail finish requirements for the interior color scheme, upholstery, and floor covering shall be in accordance with applicable references listed in Par. 2.2.2.

11.1.2 Furnishings and Equipment

Furnishings and equipment shall be provided as listed in Appendix I.

11.1.3 Soundproofing

Thermal and acoustical insulation panels shall be installed in the main cabin sidewall and ceiling. The panels shall be readily removable to facilitate structural inspection. (For internal sound levels, see Par. 3.5.)

11.2 ACCOMMODATIONS

11.2.1 Cabin Attendants' Accommodations

The cabin attendants' stations shall be located substantially as shown in Fig. 11-1. The attendants' seats shall automatically return to the folded position when unoccupied. Seat harnesses shall be provided for all attendants' seats. The attendants' panels (Fig. 11-2) shall be located near their

seated stations. One fixed service unit containing one work light and oxygen masks shall be installed at each attendants' station.

## 11.2.2 Passenger Accommodations

### 11.2.2.1 Basic Arrangement

The basic passenger cabin arrangement shall provide for 200 passengers (20 first class passengers at 40-inch seat spacing and 180 tourist class passengers at 34-inch seat spacing), as shown in Fig. 11-1. This arrangement shall be certificated.

### 11.2.2.2 Alternate Arrangements

At the option of the Buyer, the following arrangements may be certificated instead of that described above:

- 239 tourist class passengers at 34-inch seat spacing.
- 228 passengers (24 first class passengers at 40-inch seat spacing and 204 tourist class passengers at 34-inch seat spacing).
- 209 passengers (42 first class passengers at 38-inch seat spacing and 167 tourist passengers at 36-inch seat spacing).

Flexibility of interior arrangements shall be provided through modular concepts of component design.

## 11.2.3 Passenger Seats

Passenger seats, including belts, shall be installed substantially as shown in Fig. 11-1. Design of the seats shall be in accordance with the applicable reference listed in Par. 2.2.2.

The passenger seats shall be designed to the following ultimate load factors acting separately: upward, 4.5g; downward, 7.5g; forward, 9.0g; sideward, 3.0g. These load factors shall be multiplied by 1.33 for design of seat and seat belt attachments.

Seat dimensions shall provide a main aisle width of not less than 18 inches up to a height of 25 inches above the floor. Above 25 inches, the aisle width shall not be less than 20 inches.

11.2.4 Passenger Service Units

A passenger service unit shall be installed for each row of seats. Each unit shall be adjustable fore and aft to match seat spacing and shall contain individual passenger reading lights, oxygen masks, and an attendant's call button with integral indicator light. The units on the left shall be lettered, A, B, and C, and those on the right shall be lettered D, E, and F. Seat row numbers starting with 1 forward and progressing aft (except that no Row 13 shall be provided) shall also be installed on the units.

A fixed service unit containing two oxygen masks shall be installed in each lavatory.

11.2.5 Lavatory Compartments

Lavatories shall be provided and located substantially as shown in Fig. 11-1.

11.2.5.1 Lavatory Equipment

Each lavatory shall include the following equipment:
- Toilet, toilet seat, and cover

- Wash basin
- Soap dispenser
- Ash tray
- Air sickness bag dispenser
- Toilet tissue dispenser
- Toilet seat cover dispenser
- RETURN TO SEAT sign
- NO SMOKING sign
- Sanitary napkin dispenser
- Call button
- 115-volt d.c. and 28-volt d.c. shaver outlets
- Used towel disposal
- Tissue dispenser
- Paper towel dispenser
- Paper cup dispenser
- Used razor blade disposal
- Air sickness bag and sanitary napkin disposal
- Mirror
- Assist handle

The toilet seat and cover, faucet hardware, and wash basin lever-operated stopper shall be standard commercially available parts.

11.2.5.2 Lavatory Door Locks

A lavatory door lock of the sliding-bar type incorporating a large OCCUPIED indicator and interconnected with the OCCUPIED sign shall be provided for each lavatory door. It shall be possible to unlock the lavatory door lock from the outside of the lavatory compartment without tools.

11.2.5.3 Flushing-Type Toilets

Flushing-type toilets shall be provided. Each shall include a 3-phase a.c. motor to drive a pump and filter, a flushing cycle timer, and a drain valve. The flushing mechanism, including motor, pump, filter, and timer, shall be readily accessible for maintenance. Each toilet tank shall have a capacity of approximately 20 gallons. Corrosion resistant materials shall be used throughout. The flush pump shall be capable of operating dry for extended periods without damage. The ground flush and drain lines shall be protected against freezing in flight and shall not be damaged as a result of repeated freezing while the airplane is parked. The drain lines shall be capable of withstanding the full cabin pressure differential without collapsing.

11.2.5.4 Toilet Servicing Provisions

All toilets shall be capable of being serviced from external servicing panels. A 4-inch-diameter drain connection and a hinged cap shall be provided on each drain outlet. The ground flush line fittings shall be thermally insulated.

11.2.6 Galleys

The galley units shall be located substantially as shown in Fig. 11-1 and shall conform to the requirements of the "Galley Design and Installation Requirements" specification listed in Par. 2.2.2.

The galley and bar units shall be designed to the following ultimate load factors acting separately: upward, 4.5g; downward, 7.5g; forward, 9.0g, sideward, 3.0g. These load factors shall be multiplied by 1.33 for the design of fittings that attach the galley to the airplane structure. Galley mounting

provisions shall be adequate for 700-pound galley units under 12g deceleration loads.

Electrical power and water lines for the galley units shall enter the galley envelope at the bottom. Access to the disconnect fittings shall be provided through the bottom galley structure (see Par. 9.12).

11.2.7 Water System

A pressurized water supply of approximately 44 U.S. gallons, with pressure automatically maintained, shall be provided for washing, galley, and drinking purposes (see Fig. 11-3). A water quantity indicator shall be provided at an attendant's panel and at the external service panel. A back-up pressure source shall be provided.

The system supply tank shall be capable of withstanding a pressure of 125 psig. All components of the water system shall be constructed of corrosion resistant materials suitable for use with superchlorinated water. Construction shall be in accordance with the requirements of the U.S. Public Health Service.

11.2.7.1 Water System Distribution

Hot and cold water shall be supplied at each lavatory, and cold water shall be supplied at the galley units. A water shutoff valve, accessible in flight, shall be provided in the main supply line, at each lavatory wash basin, and at the galleys.

The water distribution lines shall be fabricated of materials that will sustain freezing without rupture or permanent distortion.

11.2.7.2 Filling

The service fill panel shall be located in the nose wheel well. The fill overflow valve shall be manually operable from the service fill panel. The valve shall be located in a thermally insulated area.

11.2.7.3 Water System Drainage

System drainage and purging shall be possible with pressure in the water tank. Gravity drainage shall be provided. Waste water from the lavatory basins and galleys shall be drained into the toilet tanks.

11.2.8 Stowage

Stowage provisions, including plug-in coat closets, shall be located substantially as shown in Fig. 11-1. A literature container shall be provided for each seat. Magazine racks shall be provided. Overhead racks shall be provided for stowage of blankets, pillows, coats, etc. The racks shall be of sufficient strength to withstand hand loads of passengers walking in the aisle during flight in rough air.

11.2.9 Assist Handles

An assist handle shall be provided at each main entry door, at each galley service door, and in each lavatory.

11.2.10 Cabin Entrance Areas

Self-draining moisture-resistant mats shall be provided in lieu of carpeting in both the forward and aft passenger cabin main entrance and galley service door areas.

11.2.11 Partitions and Doors

Partitions and doors shall be provided substantially as shown in Fig. 11-1 (see Par. 4.4.5). A key operated lock and viewing lens shall be installed on the door between the electronics compartment and the passenger cabin. The key operated door lock shall also be remotely controlled from the flight deck. A signalling system such as a buzzer shall be installed to notify the flight crew to open the flight deck door. Door-open warning straps shall be provided for all main entry and galley service doors.

11.2.12 Call System

A passenger-cabin attendant call system shall be installed (see Par. 9.13.).

11.2.13 Passenger Address System

A passenger address system shall be installed (see Par. 10.5.4).

11.2.14 Passenger Signs and Placards

All signs and placards shall be in the English language (the Buyer shall have the option of including a second language). Illuminated NO SMOKING, FASTEN SEAT BELT, RETURN TO SEAT, and EMERGENCY EXIT signs shall be provided (see Par. 9.11.3). Self-illuminated EXIT signs shall be provided in the ceiling above the center aisle at the emergency exits.

11.3 CARGO COMPARTMENTS

Two cargo compartments shall be located in the airplane substantially as shown in Figs. 11-4 and 11-5. The compartments shall be lined with high impact resistant material.

For fire protection, the cargo compartments shall be designed as FAR Class D.

Each compartment shall be divided into subcompartments by use of stanchions and removable partition nets. Flush-type tie-down tracks shall be provided.

11.4 EMERGENCY EQUIPMENT

The emergency equipment listed in Appendix I shall be located in the main cabin and cargo compartments substantially as shown in Fig. 11-6. The installation of emergency equipment, such as life rafts, life vests, escape slides, fire extinguishers, portable oxygen bottles, first aid kits, etc., shall be designed to provide positive identification and rapid deployment. In the design of emergency equipment and installations, consideration shall be given to airline and industry improvement studies.

11.4.1 Escape Facilities

An escape device, capable of rapid deployment, shall be installed at each main entry door, each galley service door, and each Class II exit not located over the wing. An escape rope shall be provided at each overwing emergency exit. One end of the rope shall be attached to the cabin structure above the opening. Provisions shall be made for securing the opposite end of the rope to the wing to allow use of the rope as a handrail in the event of ditching.

11.4.2 Fire Extinguishers

Portable fire extinguishers shall be installed and located as shown in Fig. 11-6.

11.4.3 Portable Oxygen

Portable oxygen bottles shall be installed and located as shown in Fig. 11-6. It shall be possible to recharge the bottles from the airplane oxygen system.

11.4.4 Crash Axes

Two crash axes shall be provided and located as shown in Fig. 11-6.

11.4.5 First Aid Kits

Two first aid kits shall be provided and located as shown in Fig. 11-6.

11.4.6 Life Rafts and Automatic Emergency Beacons

Nine 25-man life rafts shall be stowed in locations as shown in Fig. 11-6. An automatic emergency beacon shall be provided with each raft.

11.4.7 Life Jackets

One life jacket shall be provided under each passenger seat. In addition, life jackets shall be located as follows:

- One life jacket for each attendants' seat
- Five life jackets in a forward stowage compartment
- Five life jackets in an aft stowage compartment.

## 11.5 OXYGEN SYSTEM

### 11.5.1 General

An oxygen system shall be installed in compliance with applicable FAR to provide oxygen for the passengers during an emergency descent and for sustaining flight following a decompression. The passenger oxygen supply shall provide sufficient oxygen for 215 passengers and for five cabin attendants for 100-percent usage during an emergency descent from cruise altitude to 14,000 feet, and for use by 10 percent of the passengers for a period of 3 hours at a cabin altitude of 14,000 feet. The system shall be substantially as shown in Fig. 11-7. (See Par. 6.4 for flight crew oxygen system description.)

### 11.5.2 Passenger Cabin Oxygen System

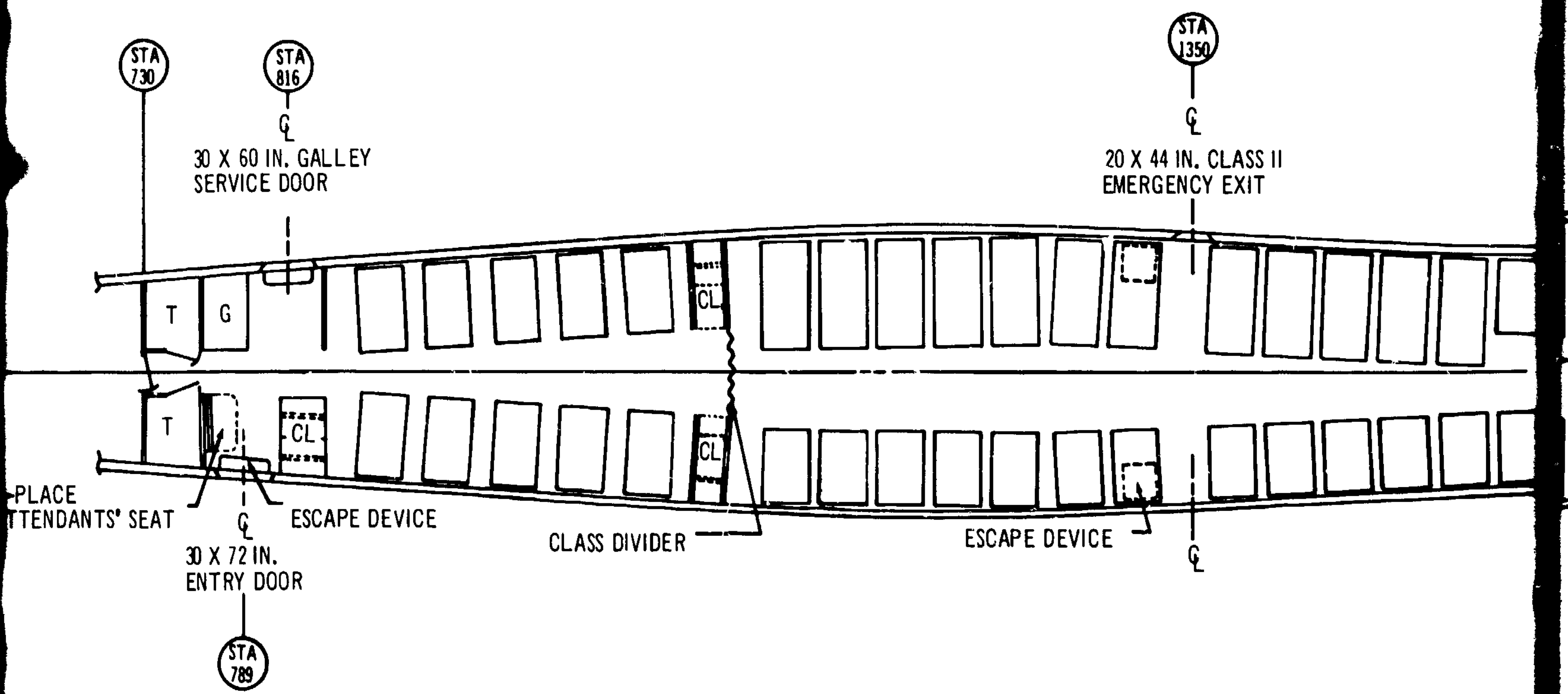
A 25-liter capacity liquid oxygen converter and evaporation coil assembly that includes an overboard discharge line from the converter safety valve shall be installed. Two continuous-flow control units, each with an automatic actuating device, shall be provided.

The system shall be automatically actuated at cabin altitudes above approximately 14,000 feet. This shall include automatic presentation of the passenger and cabin attendant oxygen masks. A warning light at the flight engineer's station shall indicate actuation of the system. In case of failure of the automatic actuating device, electrical actuation of the system shall be possible by a switch on the flight engineer's panel. System standby actuation shall be by manual operation of the control valve.

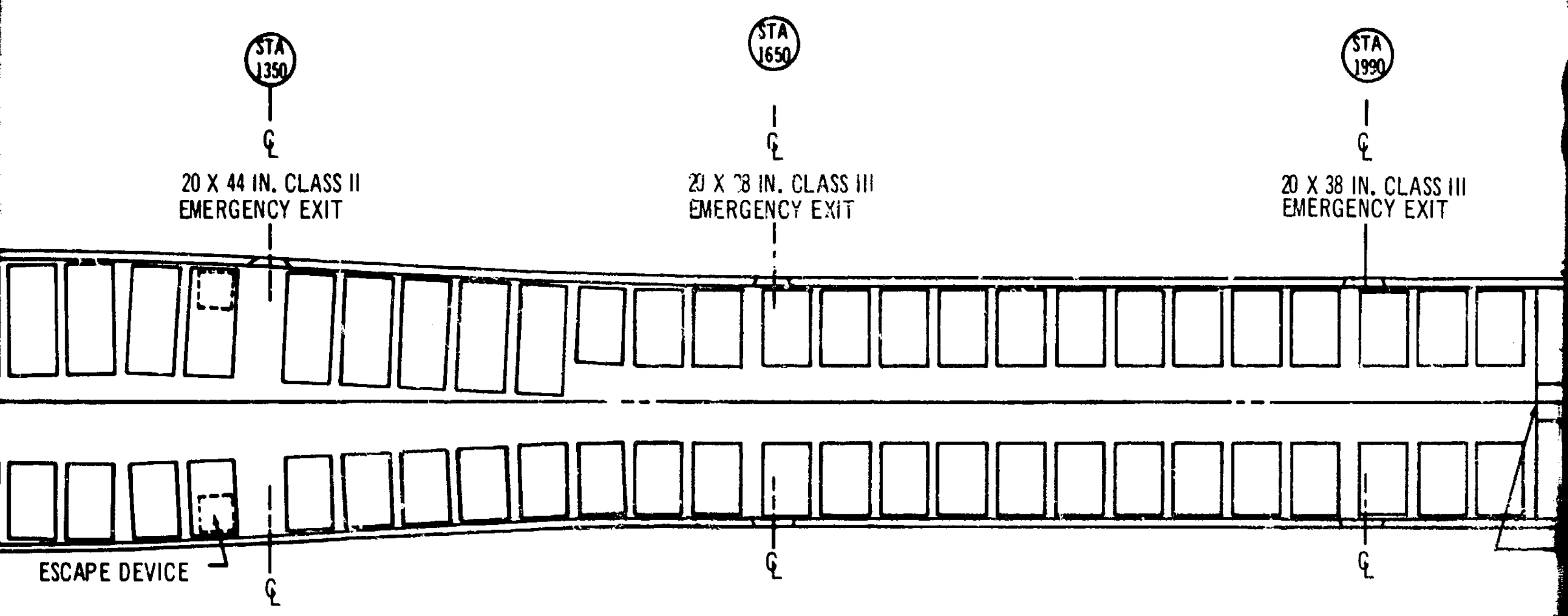
Filling of the liquid oxygen supply tanks shall be possible while the tank is on board the aircraft. The tanks shall be readily removable and replaceable to permit remote filling, if desired. A remote-reading quantity indicator and pressure indicator shall be located on the flight engineer's panel.

Tubing to the passenger service unit connectors shall be aluminum alloy. Flareless tube fittings shall be used throughout the system.

Four oxygen masks shall be provided in each passenger service unit serving three seats, and three masks shall be provided in each passenger service unit serving two seats. Two oxygen masks shall be installed in each lavatory service unit, galley work area, and cabin attendants' service unit.




20 FIRST CLASS AT 40-INCH PITCH




H

180 TOURIST AT 34-INCH PITCH (18 TO 19-INCH SEAT WIDTH)

3

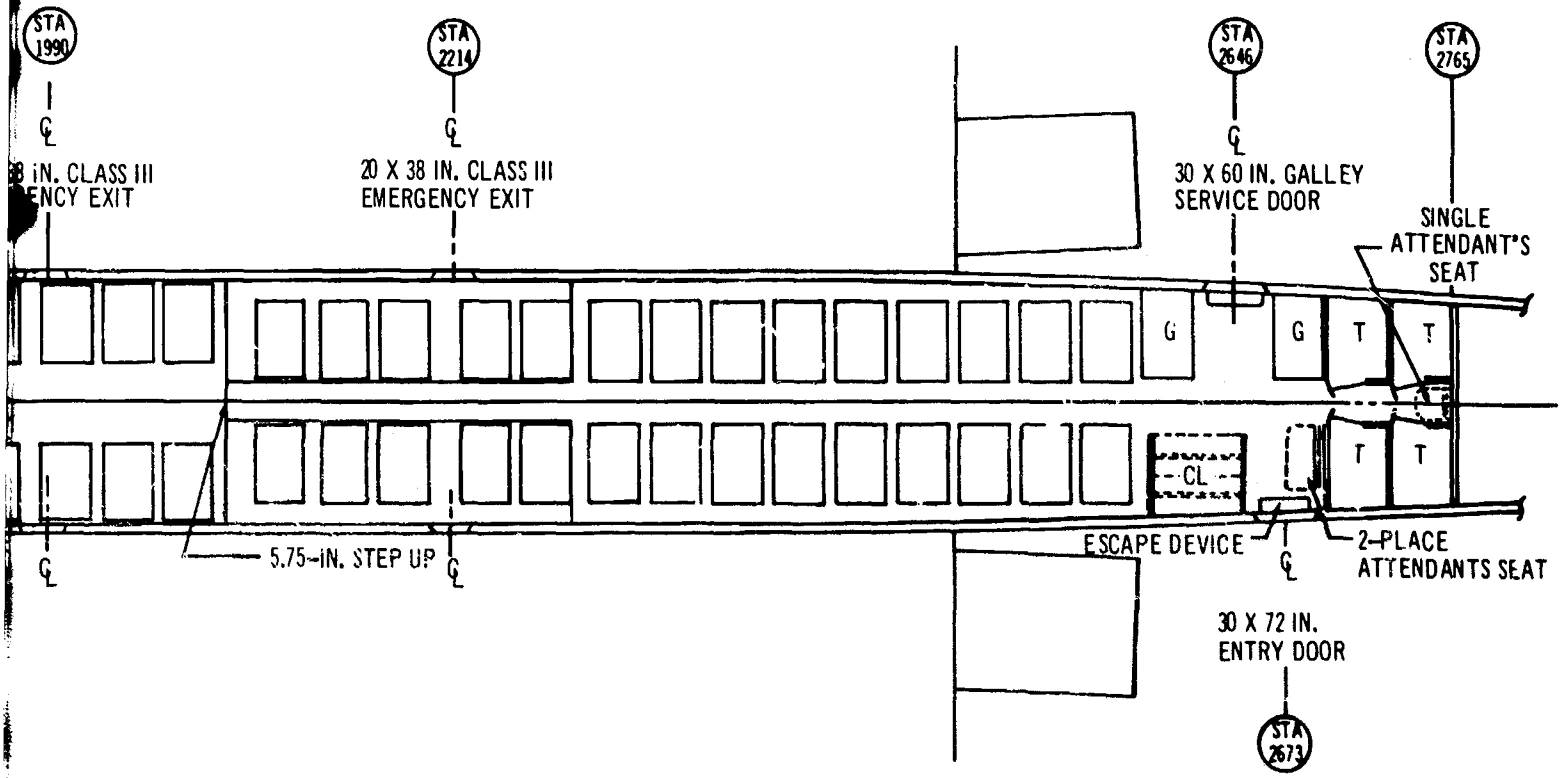



*Fig. 11-1 Passenger Arrangement*

C

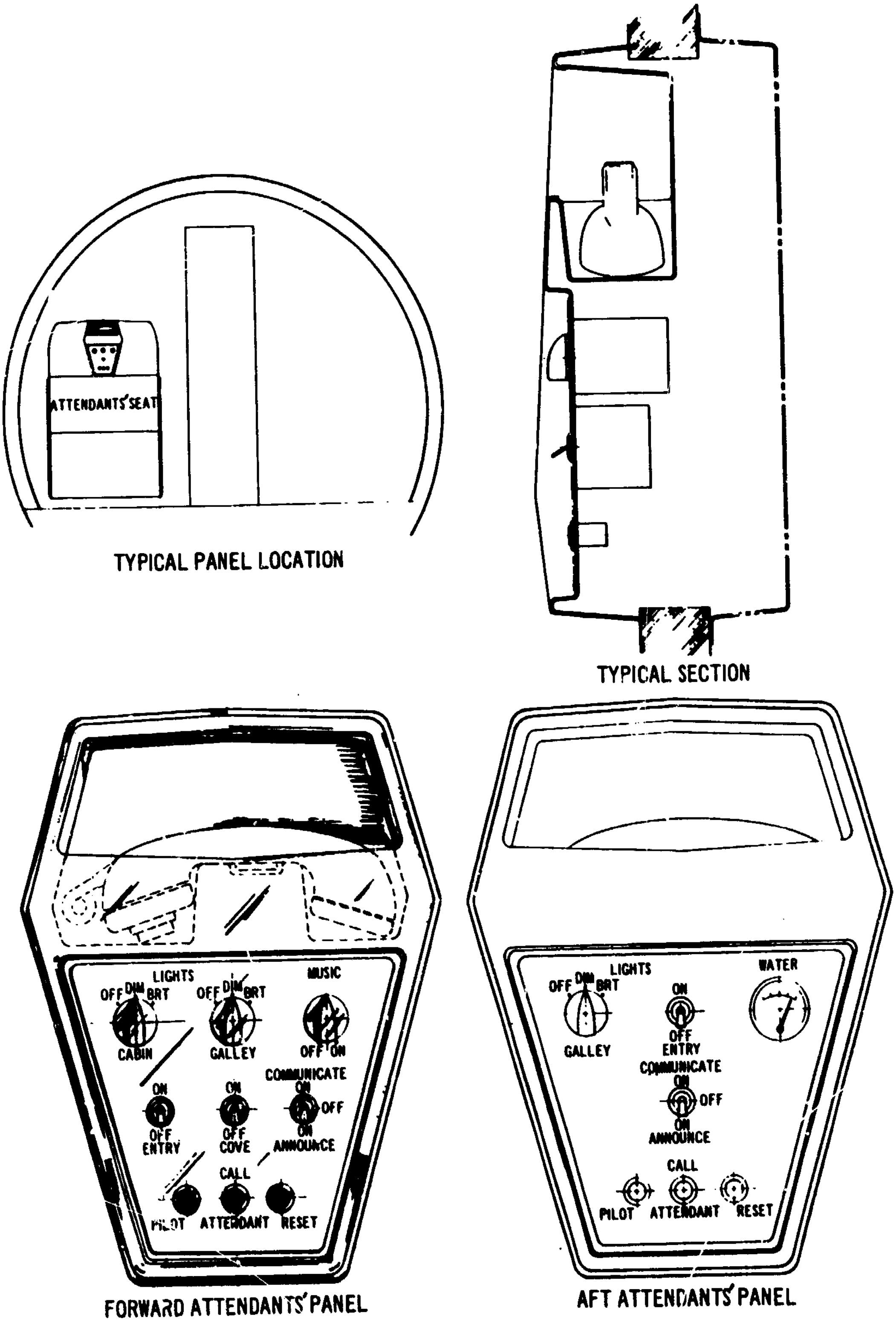



*Fig. 11-2 Attendants' Panels*

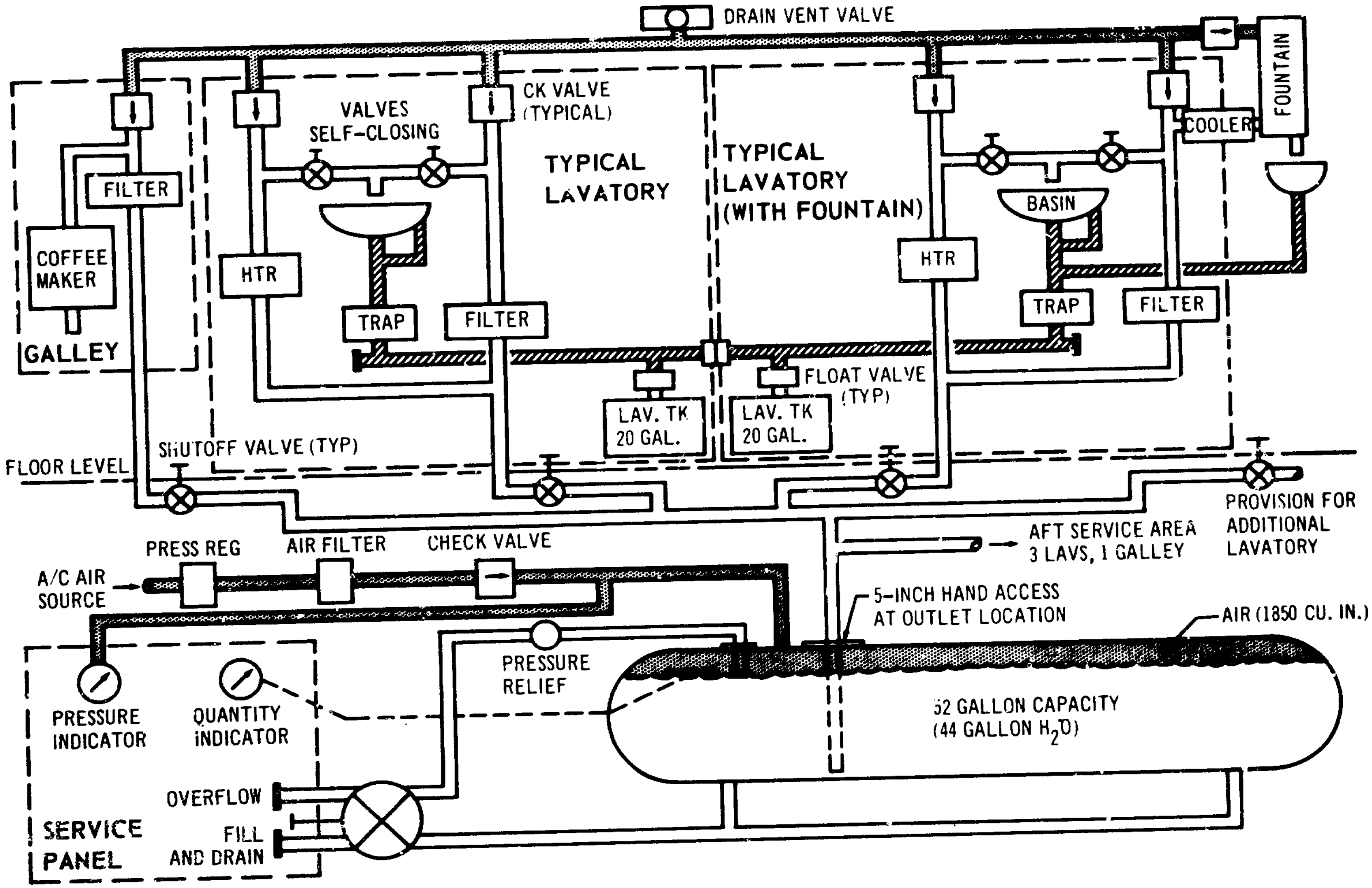



*Fig. 11-3 Pressure Water System Diagram*

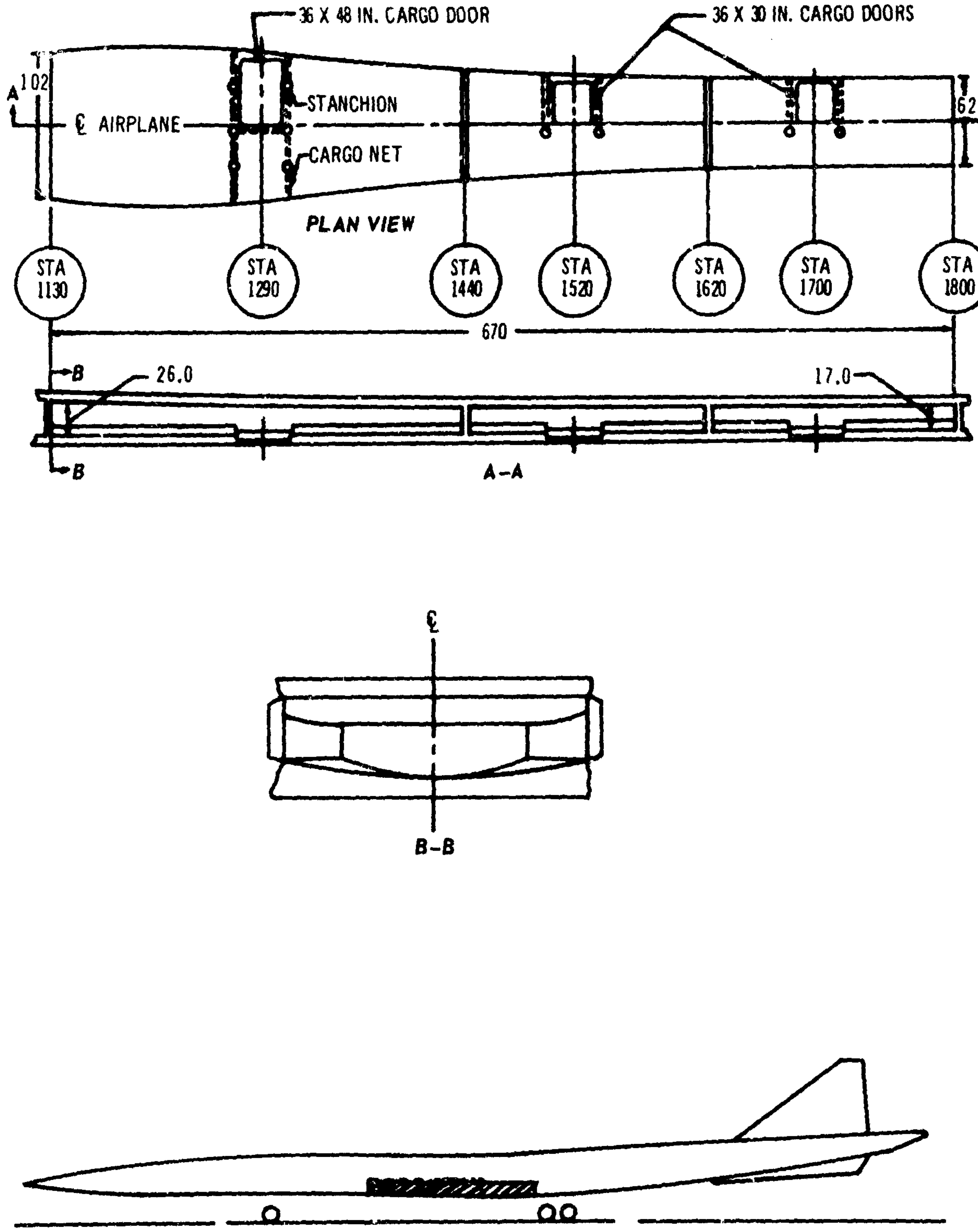



*Fig. 11–4 Lower Cargo Compartment*

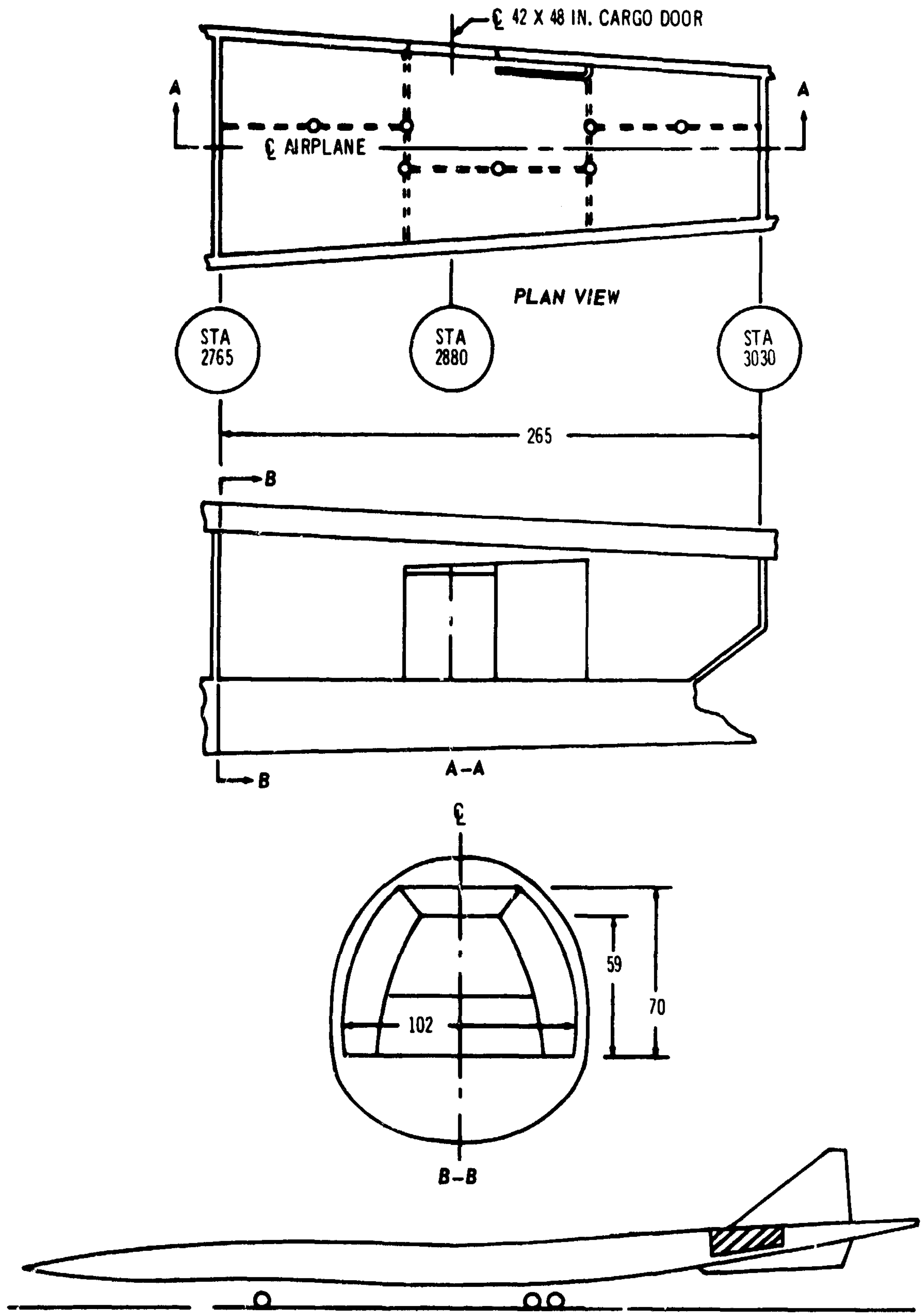
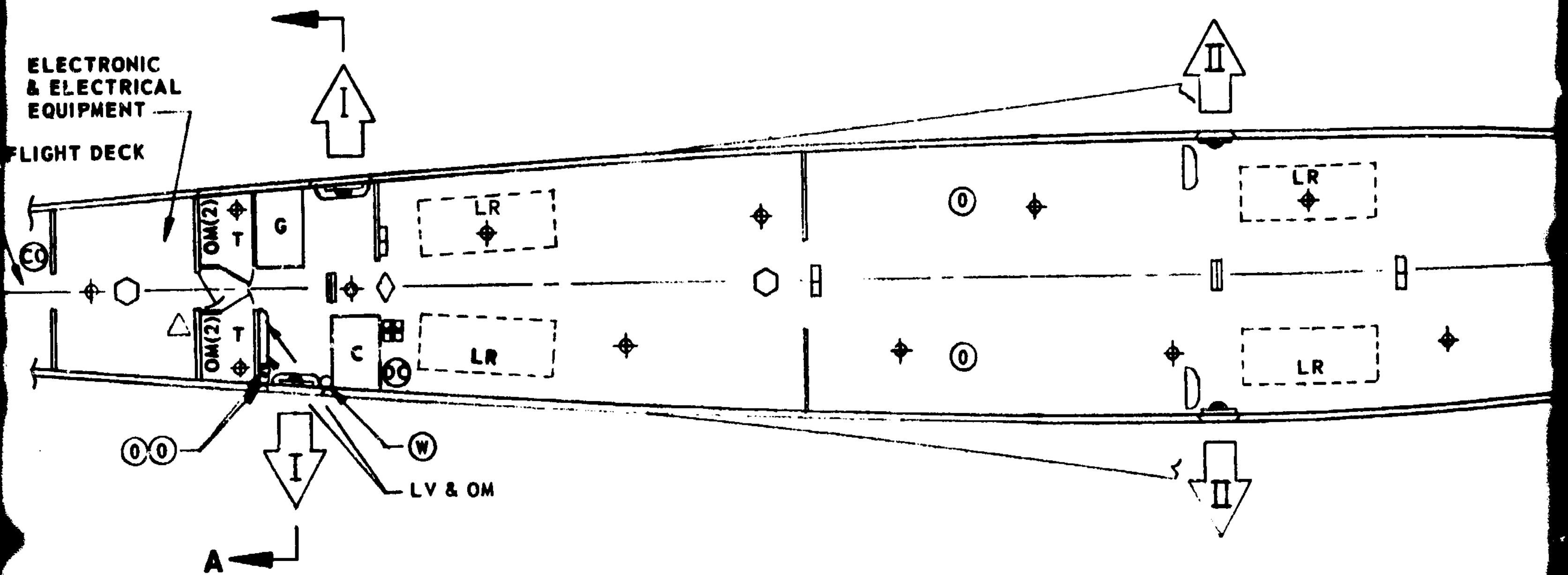
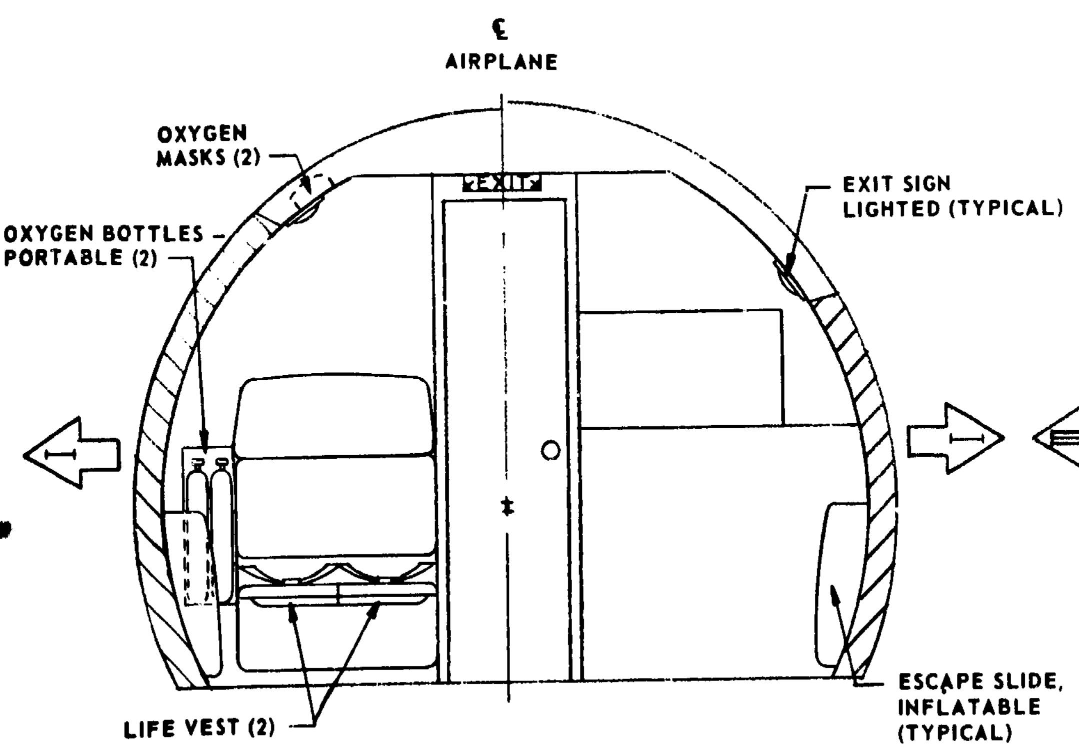
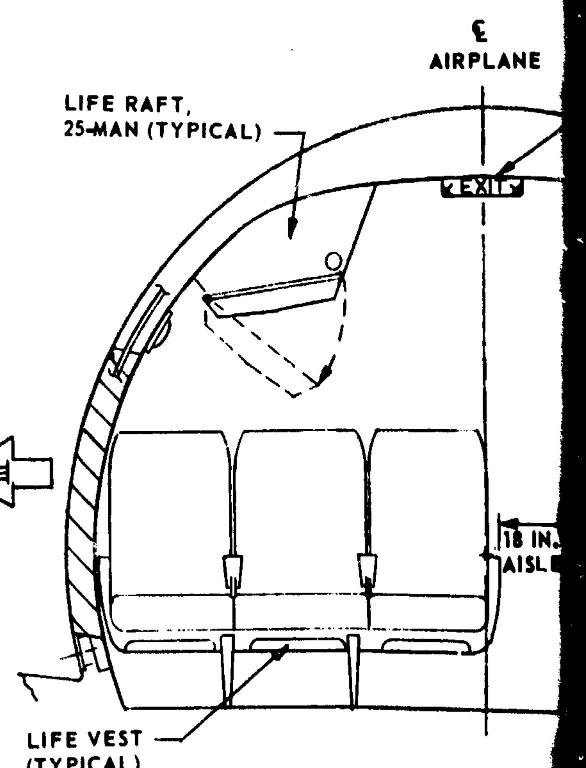



*Fig. 11-5 Upper Cargo Compartment*


ELECTRONIC & ELECTRICAL EQUIPMENT
FLIGHT DECK
OM(2)
T
G
C
LR
LV & OM
A

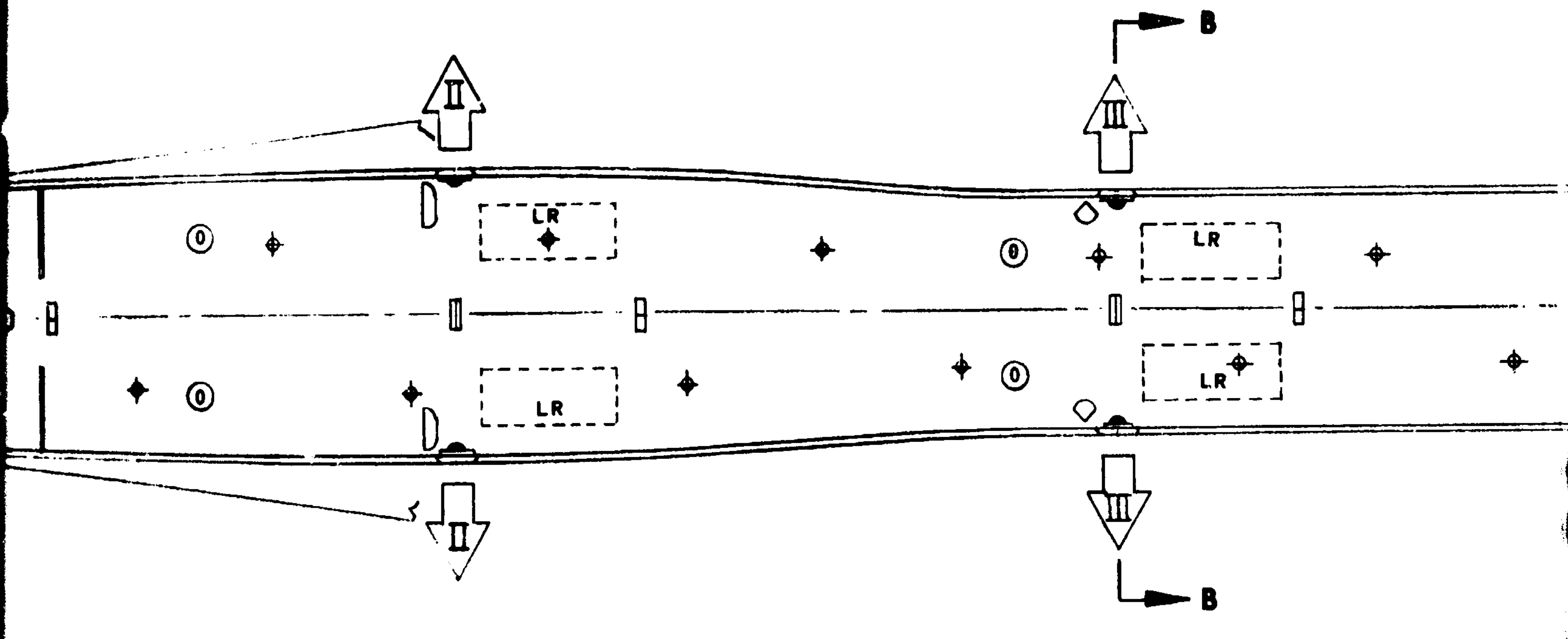

℄ AIRPLANE
OXYGEN MASKS (2)
OXYGEN BOTTLES PORTABLE (2)
EXIT
EXIT SIGN LIGHTED (TYPICAL)
LIFE VEST (2)
ESCAPE SLIDE, INFLATABLE (TYPICAL)

A-A

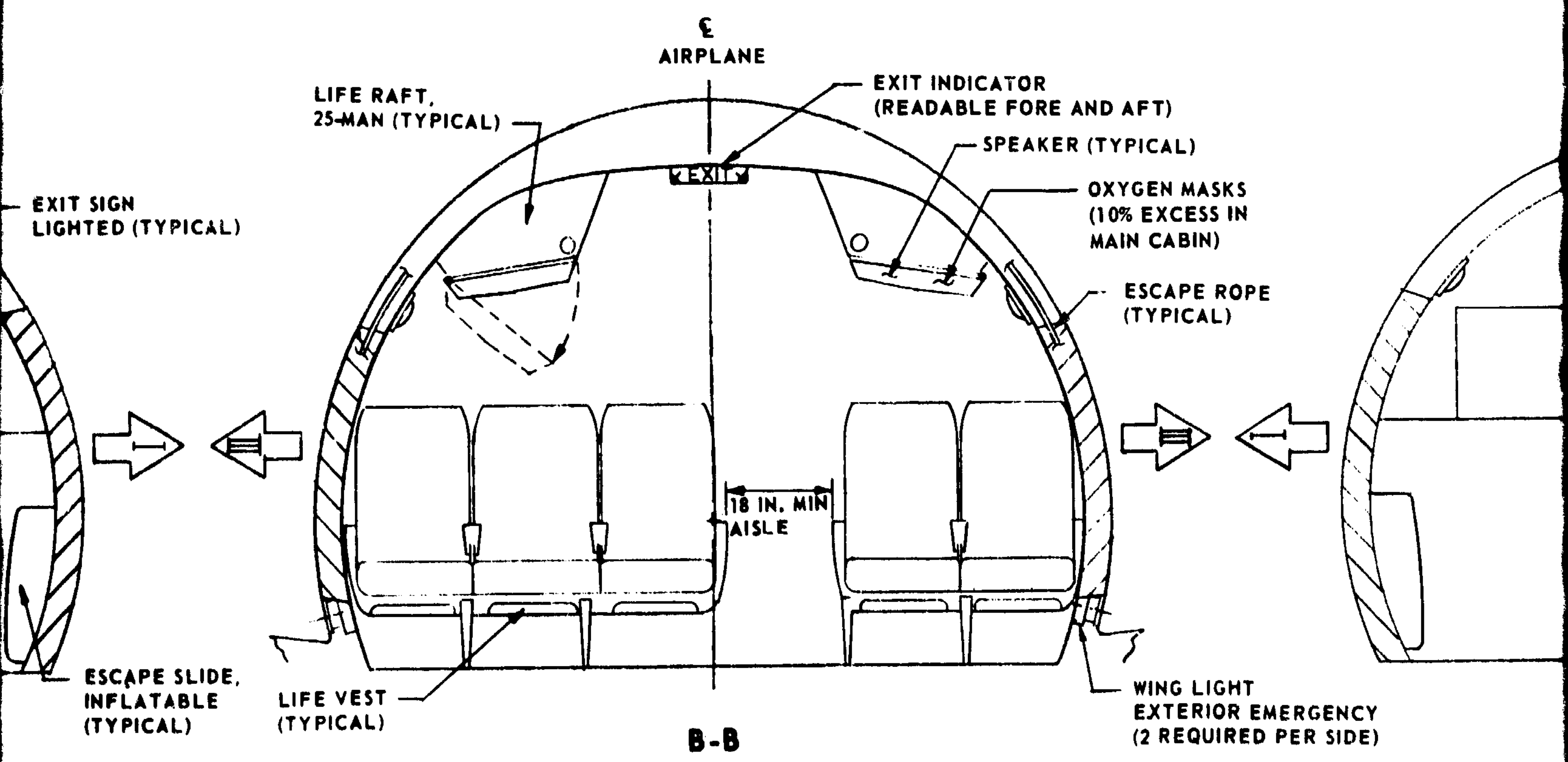

℄ AIRPLANE
LIFE RAFT, 25-MAN (TYPICAL)
EXIT
18 IN. AISLE
LIFE VEST (TYPICAL)

B-B

A

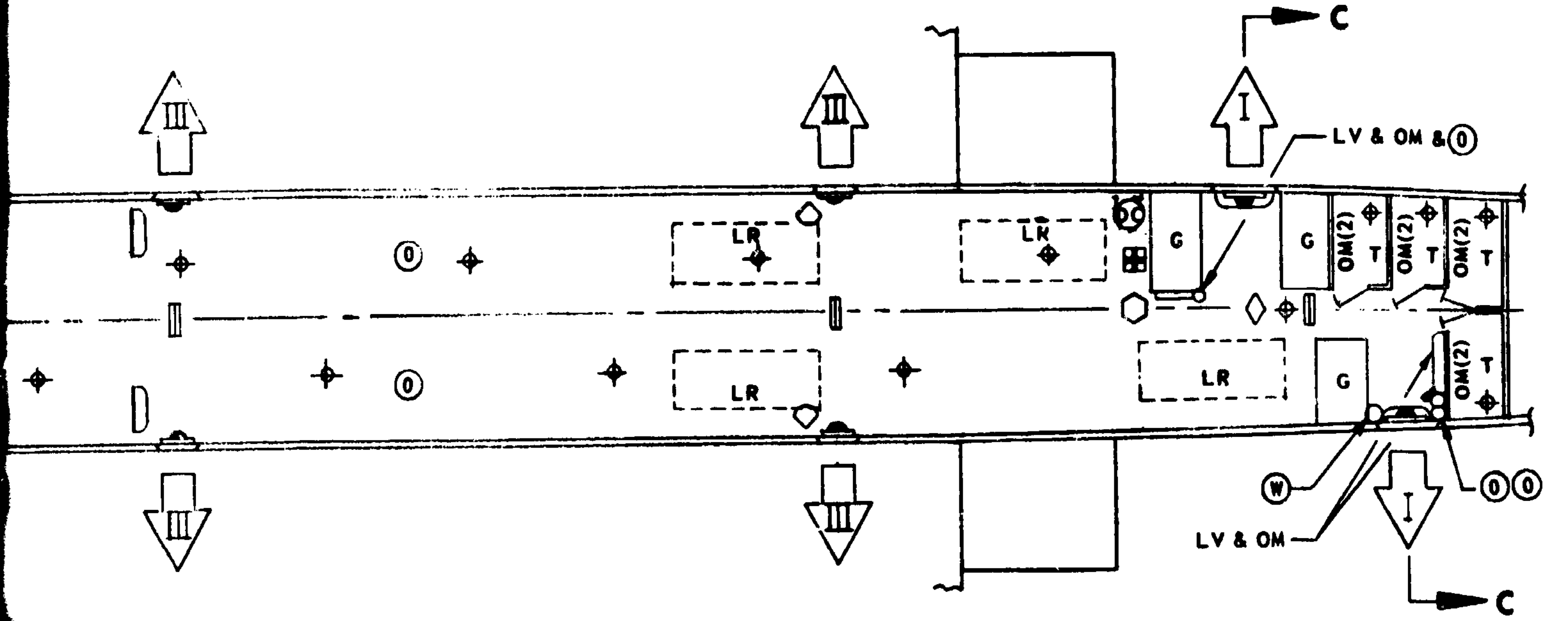


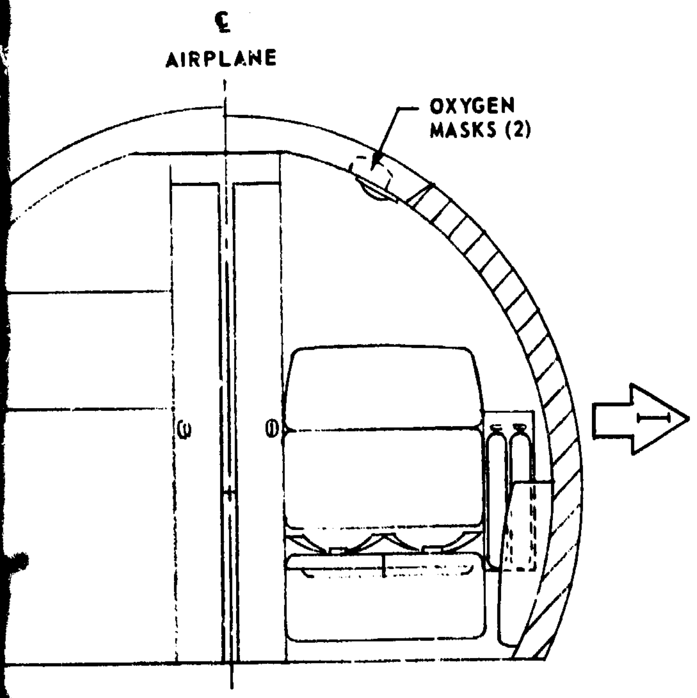

PLAN VIEW




B-B

3




C-C

- — SPEAKER, 4-INCH DIAMETER
- — EMERGENCY LIGHT, BATTERY OPERATED
- — EXIT INDICATOR, SELF-ILLUMINATED
- — EXIT SIGN, BATTERY OPERATED
- — SIGN "NO SMOKING–FASTEN SEAT BELT"
- — FIRE EXTINGUISHER, DRY CHEMICAL
- — FIRE EXTINGUISHER, WATER
- — FIRE EXTINGUISHER, $CO_2$ BULLHORN
- — CRASH AXE
- — ESCAPE ROPE
- — MEDICAL KIT AND 10 SPARE LIFE VESTS
- — ESCAPE SLIDE, INFLATABLE
- — ANNUNCIATOR
- — EMERGENCY EXIT, CLASS I
- — EMERGENCY EXIT, CLASS II
- — EMERGENCY EXIT, CLASS III
- — OXYGEN BOTTLE, PORTABLE (3.8 CU FT)
- OM — OXYGEN MASK
- LV — LIFE VEST
- LR — LIFE RAFT, 25-MAN, SELF-ERECTING
- T — TOILET
- G — GALLEY
- C — CLOSET

*Fig. 11–6 Emergency Equipment*

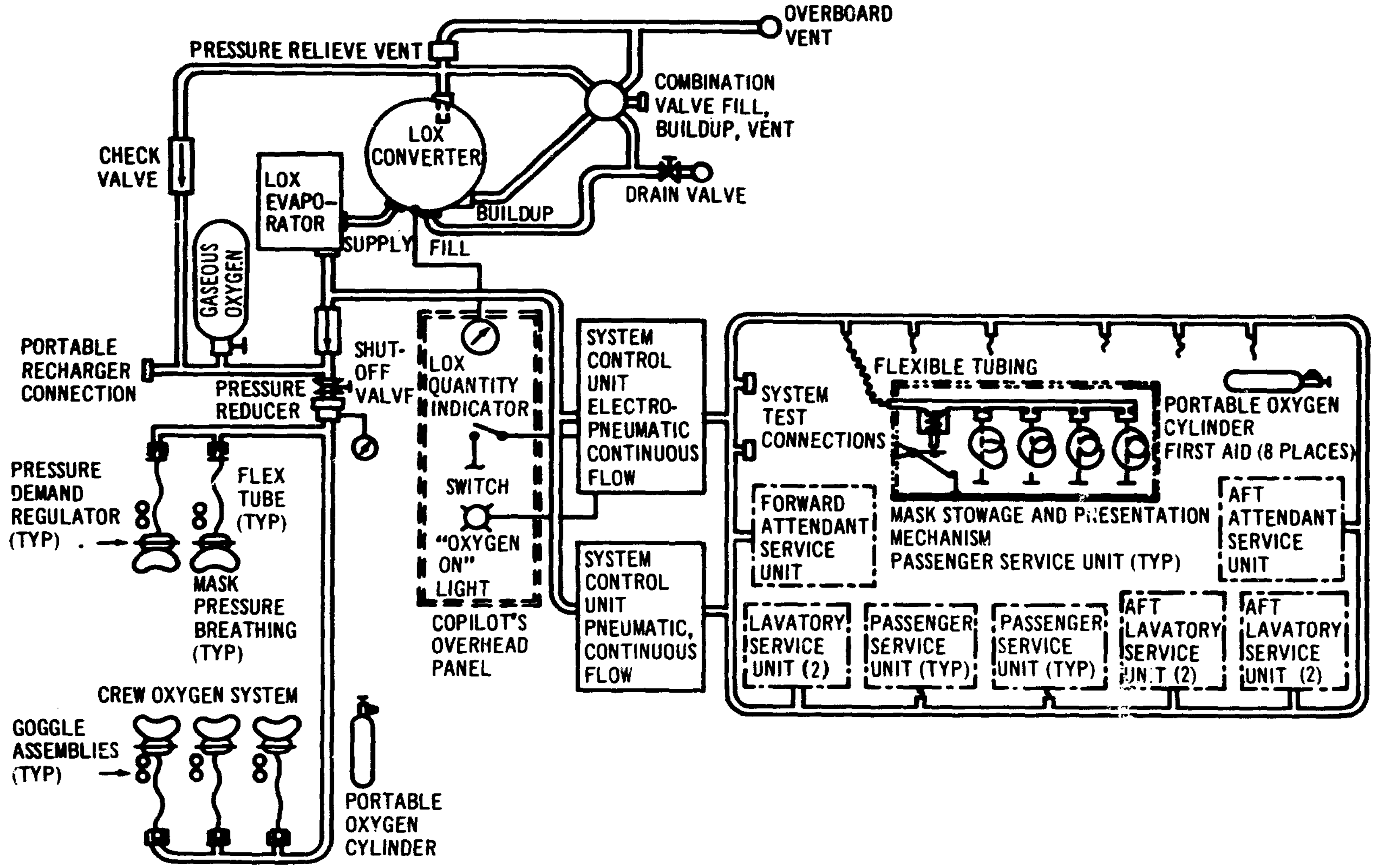



*Fig. 11–7 Oxygen System Diagram*

# 12.0 ENVIRONMENTAL CONTROL

CONTENTS



ILLUSTRATIONS

# 12.0 ENVIRONMENTAL CONTROL

12.1 GENERAL

The cabin air conditioning and pressure control systems shall be substantially as shown in Figs. 12-1 an 12-2, respectively. The normal cabin air source for air conditioning and pressurization is ram air, increased in pressure by compressors powered from the engine driven accessory gearboxes. During descent, engine compressor bleed air may be used and shall be available as an alternate air source during cruise.

Anti-icing, antifogging, and windshield rain removal systems shall be installed as defined in Par. 12.7.

SAE AIR 746 or later shall be used as a guide for the environmental control system except as superseded by any of the following requirements. ◊

Temperature readouts shall be in degrees Fahrenheit. ◊

12.2 AIR CONDITIONING SYSTEM DESCRIPTION

Four independent and essentially identical air conditioning systems shall be installed. Cabin air shall be cooled by using air/air and air/fuel heat exchangers and air cycle machines. A malfunction in any air conditioning system shall not adversely affect the operation of any of the others.

12.2.1 Conditioned Air Distribution

Four temperature zones shall be provided; one for the flight deck and three for the main cabin. A conditioned air distribution system shall be installed for each zone. A distribution

crossover duct shall be installed to ensure air supply to all areas in the event that an air conditioning system is inoperative.

Positive means shall be provided to prevent entry of combustible materials (other than dust, lint, and combustible gasses and fluids) into the return air cavity and to prevent propogation of fire from the cabin into the sidewalls and within the sidewalls.

For odor control, air from the lavatory compartments and galley areas shall be vented overboard.

12.2.2 Cabin Temperature Control

Two automatic temperature selectors shall be provided; one for the flight deck, and one for the passenger cabin. The selectable temperature range shall be from 65 to 85°F. Electrical manual override operation shall be provided for the flight deck and for each cabin zone.

12.2.3 Ozone and Radiation Detection

The air conditioning system shall be designed to limit ozone concentration. Cabin ozone concentration shall not exceed 0.2 parts per million by volume for normal operation, or 0.3 parts per million by volume for short-term duration. An ozone concentration measuring system shall be installed with indication at the flight engineer's station. Devices for detecting and monitoring cosmic radiation levels shall be provided if required.

12.2.4 Equipment Conditioning

Electronics and electrical equipment areas, wheel wells, and equipment bays shall be cooled by exhaust air from the cabin during flight. Forced air shall be provided for ground cooling of electrical and electronic equipment (see Par. 10.1.5).

12.2.5 Ground Conditioning Connector

A connection shall be provided to allow conditioned air to be supplied to the airplane distribution system from a ground unit. The connector shall be designed to permit delivering 300 pounds per minute of conditioned air at an inlet pressure of 2 psi and any temperature from 40 to 120°F.

12.2.6 Fire Detection and Control

Each of the four equipment bays that contain heat exchangers employing fuel shall be physically isolated in fireproof enclosures and shall be provided with fire detection and extinguishing systems (see Par. 5.9.4).

## 12.3 AIR CONDITIONING PERFORMANCE REQUIREMENTS

The performance specified in Pars. 12.3.1 and 12.3.2 shall be met for normal airplane operations in the design atmospheric ambient temperature and humidity conditions shown in Figs. 12-3 and 12-4, respectively.

12.3.1 Cabin Temperature Control Requirements

During ground operations, with engines at approximately idle power, the system shall have the capacity to cool the flight deck and the cabin to 85°F with 215 passengers, and to heat these areas to 75°F with 43 passengers.

During flight operations, the system shall have the capacity to cool the flight deck and the cabin to 85°F at sea level and to 75°F at 20,000 feet and above, with straight-line variation in temperature at intermediate altitudes with 215 passengers. The system shall have the capacity to heat these areas to 75°F at all operating altitudes with 43 passengers.

It shall be a design objective to meet the cooling and heating requirements with one conditioning system inoperative.

Under stabilized cruise flight conditions, the cabin temperature gradients for the seating arrangement shown in Fig. 11-1 shall not exceed the following:

- A total of 6°F variation at any seat position measured on the seat centerline from 2 inches above the floor to seated head height
- A total of 5°F variation between seats in a fore and aft vertical plane measured on the seat centerline at the same height above the floor from 2 inches above the floor to seated head height
- A total of 4°F variation between any seats at the same body station measured on the seat centerline at the same height above the floor from 2 inches above the floor to seated head height.

The above gradients shall apply for a uniformly distributed passenger load, and apply to the passenger cabin only with the same temperature selected for all passenger zones. Areas adjacent to lavatory and galley facilities are excluded.

The maximum supply steady state temperature of air entering the cabin from the supply ducts shall not normally exceed 120°F.

Separate temperature control of cargo compartments shall not be provided; however, during normal operation, the average stabilized compartment temperature shall be not less than 35°F or more than 100°F.

Maximum (normal and emergency) passenger cabin interior sidewall surface temperatures and inner window pane surface temperatures shall not exceed 120°F. ◊

All temperatures specified in this paragraph are dry bulb temperatures. ◊

12.3.2 Ventilation

The system shall have the capability of supplying 20 cubic feet per minute of fresh air for each of 215 passengers and 5 cabin attendants.

The system shall have the capability of supplying 20 cubic feet per minute of fresh air per crew member (5 total) to the flight deck, plus the additional flight deck compartment ventilation required for cooling.

## 12.4 CABIN PRESSURE SYSTEM DESCRIPTION

The cabin pressure control system shall be substantially as shown in Fig. 12-2.

A variable isobaric controller shall be located on the flight engineer's panel and shall permit selection of automatic control of cabin altitudes from -1000 feet to +10,000 feet. A variable rate selector shall permit selecting rate of change of cabin altitude from 50 to 2000 feet per minute. Barometic correction shall be provided.

Outflow, vacuum relief, and safety valves shall be installed to provide selected cabin pressure control, vacuum relief, and pressure relief, respectively.

Override control of each outflow valve shall be provided on the flight engineer's panel. Separate manually actuated valves, in series with each outflow valve, shall permit shutting off airflow through the outflow valves. These valves shall provide vacuum relief after actuation and shall be actuated closed from the flight engineer's station.

12.5 CABIN PRESSURE SYSTEM PERFORMANCE REQUIREMENTS

The performance specified in this paragraph shall be met for normal airplane operations in the design atmospheric ambient temperature and humidity conditions shown in Figs. 12-3 and 12-4, respectively.

The cabin pressurization system shall be capable of maintaining a sea level cabin to an airplane altitude of 34,300 feet, and a 6000-foot cabin at an airplane altitude of 70,000 feet. Satisfactory cabin pressurization shall be obtainable with any two engines inoperative.

Cabin pressure relief shall limit the maximum cabin-to-ambient pressure differential to 12.34 psi. Vacuum relief shall limit the negative differential to 1.00 psi. It shall be possible to reduce inflight and on-ground cabin-to-ambient pressure differentials to 0.35 and 0.25 inch of mercury, respectively. A cabin altitude limiter shall be installed to prevent the cabin altitude from exceeding a nominal 14,000 feet. No single failure in the cabin pressure system shall cause loss of cabin pressure.

The pressurization system shall have the capability of limiting the cabin altitude to 25,000 feet with a 42-square-inch hole in the pressure shell.

## 12.6 CONTROLS AND INDICATORS

Controls and indicators for the environmental control system shall be mounted at the flight engineer's station. These shall include:

- Switches to control each conditioning system, the high pressure manifold system, outflow valve override systems, and intrawall exhaust system
- Temperature controls for the flight deck and main cabin
- Temperature indication for selective monitoring of cabin supply duct and each passenger compartment zone
- Position indication for each temperature control valve
- Cabin pressure controls for both automatic and manual operation
- An aural warning device to sound in the flight deck whenever the cabin altitude exceeds a nominal 10,000 feet.

## 12.7 ICING PROTECTION, ANTIFOGGING, AND WINDSHIELD RAIN REMOVAL

### 12.7.1 Design Conditions

The airplane shall be certificated with an icing protection system designed to allow safe flight through icing conditions as defined by FAR 25.1419.

### 12.7.2 Wing, Tail Surfaces, and Radome Anti-Icing

The wings, tail surfaces, and radome shall not be anti-iced.

12.7.3 Engine Icing Protection

The engine inlet cowl lip, inlet centerbody, and centerbody support struts shall be anti-iced by engine bleed air modulated by a flow regulating device and controlled by a shutoff valve. The engine inlet shock control total pressure sensors shall be anti-iced.

The engine inlet guide vanes and bearing support struts will be anti-iced by a system provided by the engine manufacturer.

Four switches, one for each propulsion pod, shall be provided to control all engine anti-icing system shutoff valves. Means shall be provided to check the functioning of the shutoff valves. The controls and indicators shall be mounted on the pilots' overhead panel.

12.7.4 Pitot Tube Anti-Icing

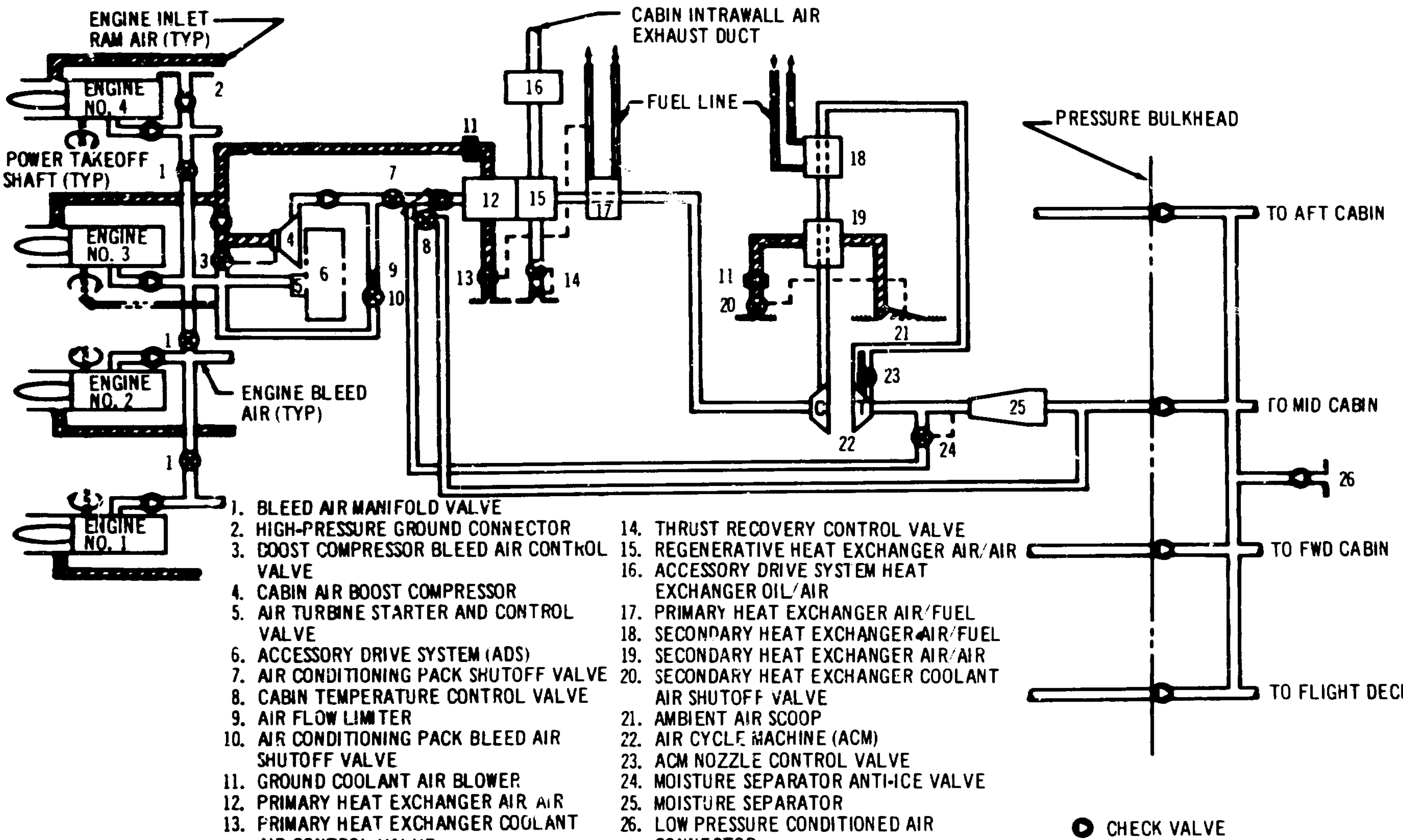
Pitot tubes shall be electrically heated. Indicators and switches shall be provided for operating control.

12.7.5 Windshield Anti-Icing and Antifogging

Flight deck windshields shall be heated by electrically conductive coatings for anti-icing and antifogging protection. The system shall be used to control the interlayer temperature of the forward windshields to obtain maximum bird impact resistance. Controls and indicators shall be provided on the pilots' aft control stand.

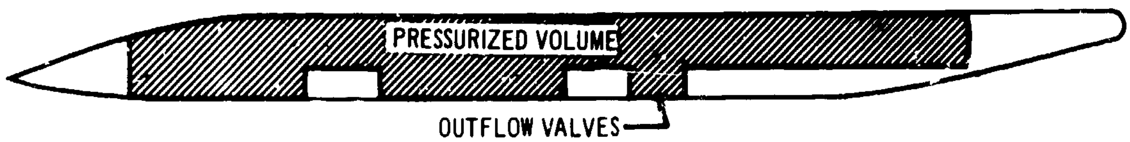
### 12.7.6 Windshield Rain Removal

Rain shall be removed from the forward windshields by a chemical rain repellent system, augmented as necessary for taxi conditions by a wall jet air blast system. Controls shall be located on the pilots' overhead panel.




1. BLEED AIR MANIFOLD VALVE
2. HIGH-PRESSURE GROUND CONNECTOR
3. BOOST COMPRESSOR BLEED AIR CONTROL VALVE
4. CABIN AIR BOOST COMPRESSOR
5. AIR TURBINE STARTER AND CONTROL VALVE
6. ACCESSORY DRIVE SYSTEM (ADS)
7. AIR CONDITIONING PACK SHUTOFF VALVE
8. CABIN TEMPERATURE CONTROL VALVE
9. AIR FLOW LIMITER
10. AIR CONDITIONING PACK BLEED AIR SHUTOFF VALVE
11. GROUND COOLANT AIR BLOWER
12. PRIMARY HEAT EXCHANGER AIR/AIR
13. PRIMARY HEAT EXCHANGER COOLANT AIR CONTROL VALVE
14. THRUST RECOVERY CONTROL VALVE
15. REGENERATIVE HEAT EXCHANGER AIR/AIR
16. ACCESSORY DRIVE SYSTEM HEAT EXCHANGER OIL/AIR
17. PRIMARY HEAT EXCHANGER AIR/FUEL
18. SECONDARY HEAT EXCHANGER AIR/FUEL
19. SECONDARY HEAT EXCHANGER AIR/AIR
20. SECONDARY HEAT EXCHANGER COOLANT AIR SHUTOFF VALVE
21. AMBIENT AIR SCOOP
22. AIR CYCLE MACHINE (ACM)
23. ACM NOZZLE CONTROL VALVE
24. MOISTURE SEPARATOR ANTI-ICE VALVE
25. MOISTURE SEPARATOR
26. LOW PRESSURE CONDITIONED AIR CONNECTOR

*Fig. 12–1 Air Conditioning System Diagram*



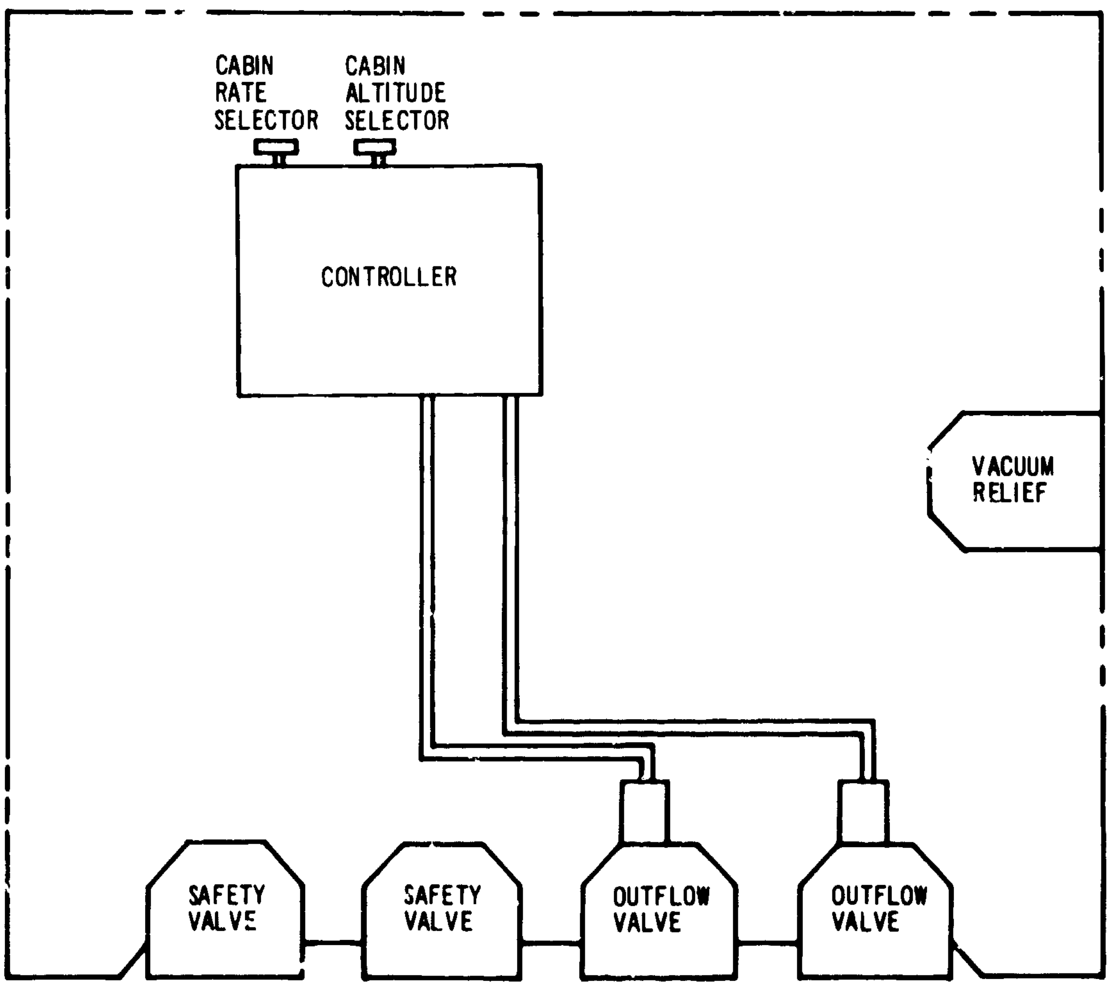




*Fig. 12-2 Pressure Control System*

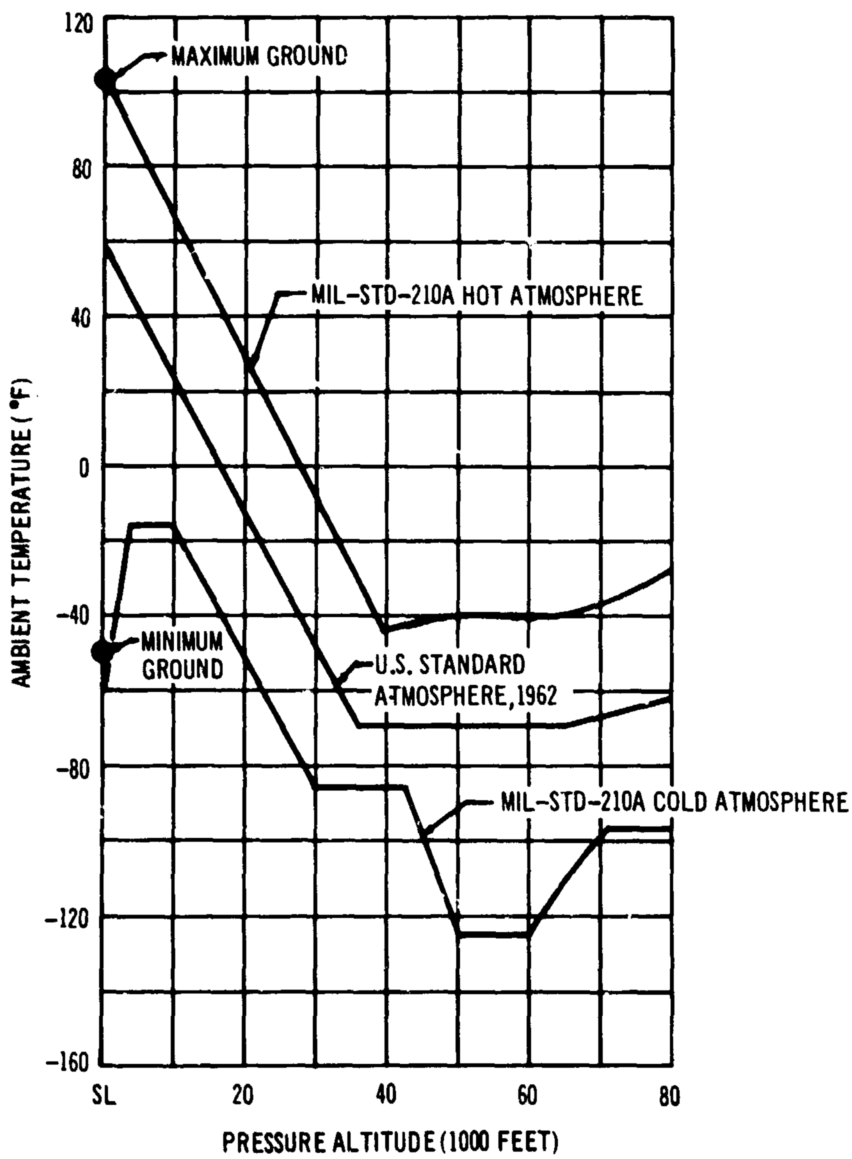



*Fig. 12-3 Design Ambient Temperature*

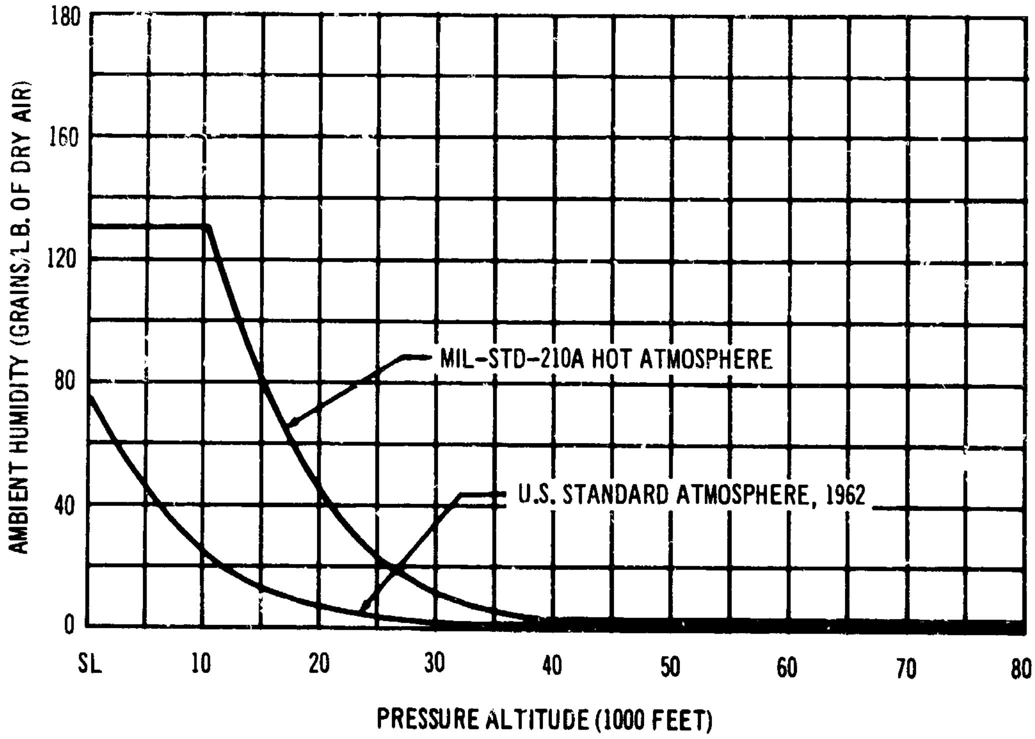



*Fig. 12-4 Design Humidity Conditions*

# 13.0 MAINTENANCE

CONTENTS

# 13.0 MAINTENANCE

## 13.1 GENERAL

Primary considerations in the design of the airplane shall be to provide the maintenance and accessibility features necessary to allow complete ground handling of the airplane in 30 minutes for through flights and 90 minutes for turnaround flights under full-load conditions and to support a commercial airline average airplane use of 13 hours per day. In addition, wherever practicable, the ground operations of the airplane shall be compatible with existing airline practices and ground equipment. To achieve this end, the following objectives shall be considered:

- Design that will ensure minimum through-service, turnaround, and other service downtime
- Installation of selective automatic checkout systems
- Minimum ground support equipment
- Maximum use of existing ground support equipment
- Minimum reliability standards equal to or better than those projected for 727 subsonic jet aircraft (analyses and tests shall be used to substantiate this level of reliability).

For more detailed information on system and ground support characteristics, see applicable sections of this Specification.

### 13.1.1 Service Markings

Permanent nameplates to indicate the type of fluids, volumes, and/or pressures shall be provided on hydraulic fluid and potable water tanks and for landing gear oleos, oil-filled gearboxes, etc. Markings shall be photo-etched, engraved, or steel stamped and shall be in the applicable units specified in Par. 2.11.

Permanent identification shall be provided at service points for potable water, oxygen, fuel, and hydraulic systems and for other systems requiring servicing.

13.1.2 Maintenance Markings

Paint film decals or metalcals shall not be used on external surfaces of the airplane. Major body and wing stations shall be identified.

Fluid lines, other than fuel, shall be identified to show type of fluid, function, and flow direction. Fluid line check valves and relief valves other than fuel shall be identified with markings adjacent to the valves showing valve type and flow direction. Fuel lines shall be identified to show type of fluid and function. The design of fuel check valves shall preclude reversed installation.

Suitable markings shall be provided to distinguish between similar components mounted adjacent to each other. System isolation features shall be clearly identified.

13.1.3 Access

13.1.3.1 Structure

Access openings and inspection panels shall be provided where required in the airplane structure.

13.1.3.2 Control Panels

The pilot's main and overhead panels and the flight engineer's panels shall be designed to provide quick access to the rear side.

13.1.3.3 Control Stand

Access to the interior of the pilot's control stand shall be provided by quickly removable side panels.

13.1.3.4 Wheel Well Access

Provisions shall be made for opening the nose gear doors and the main landing gear doors on the ground to facilitate maintenance. Provisions shall also be made to prevent inadvertent closing of the doors.

13.1.3.5 Cowling

The propulsion pods shall include hinged cowl panels, equipped with quick-disconnect latches to permit access to the engine compartment. It shall be possible to remove the cowl panels with hand tools.

13.1.3.6 Fuel Tanks

Fuel tanks shall be completely accessible through man-sized openings and crawl-ways for inspection and resealing.

13.1.3.7 Control Cables

Adequate access shall be provided for inspection and maintenance of control cables throughout the airplane.

13.2 SERVICING FEATURES

13.2.1 Lubrication

All lubrication fittings shall be designed for use with standard aircraft lubrication equipment. Lubrication channels shall be provided in bushing-type bearings.

13.2.2 Cleaning

It shall be possible to clean the exterior and interior surfaces of the aircraft with commercially available cleaning agents.

13.3 MAINTENANCE FEATURES

13.3.1 Towing

Towing lugs shall be provided in accordance with Par. 4.1.8.

13.3.2 Jacking

Jacking points shall be provided in accordance with Par. 4.1.7.

13.3.3 Painting

Light colored paint shall be applied to the interior surfaces of wheel wells, accessory drive compartments, air conditioning compartments, lower Section 41, and other service areas. Painting shall be confined to hard-surfaced areas.

13.3.4 Rigging

Means shall be provided at system valves and actuators to facilitate rigging.

Rigging pin holes and/or marks shall be provided throughout the cable control system to facilitate rigging.

13.3.5 System Checkout

Reasonable test techniques shall be developed for all operating components of the airplane for airline preflight and maintenance operations.

## 13.4 OVERHAUL FEATURES

13.4.1 Hoisting

Provisions shall be made for hoisting into position and handling of assemblies or components in accordance with Par. 4.1.9.

13.4.2 Leveling

Visual leveling indicators shall be provided for rapid determination of airplane lateral and longitudinal attitudes when parked.

13.4.3 Weighing

Standard-type airplane weighing devices shall be usable for airplane weighing.

13.4.4 Alignment Points

Points shall be provided to permit alignment checking of the airframe. Alignment points shall be readily identifiable.

# 14.0 STANDARD PARTS, INTERCHANGEABILITY, AND REPLACEABLILITY

14.1 STANDARD PARTS

AN, MS, and NAS standard parts, including rivets, bolts, screws, nuts, fittings, bearings, etc., shall be used wherever practicable. Boeing commercial standard parts or other commercial parts may be used at the option of the Seller. The use of Boeing standard parts shall be held to a minimum. ◊

14.2 INTERCHANGEABILITY

14.2.1 Definitions

The term "interchangeability" is defined as that quality which will allow a part to substitute or be substituted for a part of the same part number designation and meet all physical, functional, and structural requirements and be installed by the application of attaching means only (bolts, nuts, screws, washers, pins, etc.). This specifically precludes the need for trimming, cutting, filing, reaming, drilling, shimming, and forming during installation. No tools other than those normally available to service mechanics are required for installation of the item. No operation or alterations except designed adjustments are required on supporting and surrounding structure in order to install the item.

NOTE: Interchangeability of assemblies does not necessarily mean that the components thereof are interchangeable.

The term "replaceability-interchangeability to attach points only" is defined as that quality which will allow a part to

substitute or be substituted for a part of the same part number designation and meet all physical, functional, and structural requirements and requires only the application of attaching means (bolts, nuts, screws, washers, pins, etc.) and only minor trim of the item to suit surrounding structure. This specifically excludes drilling and/or reaming of attach points during installation. It allows use of adjustment operations such as shimming, drilling, and/or reaming of other than attach points, cutting, sawing, filing, etc. No tools other than those normally available to service mechanics are required for installation of the item.

NOTE: "Minor trim" is defined as removal of a minimum of excess periphery material, which can be accomplished in less than 1 hour per linear foot of trim by use of hand tools.

14.2.2 List of interchangeable and Replaceable-Interchangeable Items

Interchangeability shall be limited to the items listed below. Items followed by an asterisk are replaceable-interchangeable.

- Wing tips*
- Flaps
- Leading edge devices
- Spoilers
- Wing pivot bearing assembly
- Cove lip doors
- Outer wing assembly (from bearing lugs outboard)
- Ailerons
- Aileron tabs (if used)
- Flap tracks
- Fore flaps
- Stabilizer (at attach points)*

- Stabilizer movable trailing edge
- Rudders
- Pilot's center aisle control stand assembly (all major components to be interchangeable or replaceable)
- Propulsion pod assembly, including engines and engine accessories
- Cowling and cowl panels
- Propulsion pod inlets
- Nose gear assembly (and all major components)
- Main gear assembly (and all major components)
- Tail gear assembly (and all major components)
- Flight deck instrument and control panels
- Nose section windows
- Radome
- Movable body nose section*
- Crew seats
- Flight deck windshields and passenger cabin windows
- Control sticks and rudder pedals
- Control system components such as bellcranks, levers, and push-pull rods
- Fuel tank access doors
- Bladder fuel cells
- Landing gear doors (nose and main)*
- Hydraulic tanks and system accessories
- Passenger water tank
- Landing light assembly
- Toilet tanks and lids
- Cables
- Fuselage tail cone
- Window shades
- Cabin insulation panels
- Passenger cabin floors
- Passenger cabin partitions and passenger compartment bulkheads and interior personnel doors

- Crew and passenger seat cushions and covers - seat back and bottom
- Passenger seats
- Passenger service units (except location legend)
- All exterior cargo doors*, main entrance doors*, galley service doors*, emergency exit doors*, heater and air-conditioning doors*
- All parts required to be installed or removed to convert the interior arrangement to any of the configurations listed in this specification.

14.3 REPLACEABILITY

14.3.1 Definition

The term "replaceability" is defined as that quality which will allow a part to substitute or be substituted for a part of the same part number designation and meet all physical, functional, and structural requirements, but which may require operations in addition to the attaching means. Such operations may be performed by the use of hand tools normally available to service mechanics, and will not normally include those for which special equipment is required, such as spotwelding, heat treating, etc.

14.3.2 List of Replaceable Items

Replaceability shall be limited to the following items:

- Wing leading edges
- Wing leading edge access panels
- Wing fillets
- Passenger entry, galley, and cargo door scuff plates
- Maintenance access doors

- Passenger cabin interior items
- Vertical fin tip
- Vertical fin leading edge
- Stabilizer tip
- Stabilizer leading edges
- Propulsion pod gap covers
- Ventral fin

Access and inspection panels whose replacement can be accomplished with the use of standard gage sheet metal without forming or assembling are not listed in this section.

# APPENDIX I
## Equipment

CONTENTS

GENERAL NOTES

This appendix lists selected major items of equipment used on the airplane(s) described in this document.

The Seller reserves the right to substitute equivalent equipment and/or accessories in lieu of those specified herein whenever such substitution is necessary to prevent delay in installation or delivery, improve the product, or meet the requirements of the FAA.

As stated in the introduction to this Specification, such equipment items as passenger seats, galleys, electronics equipment, and emergency equipment, which normally are Buyer-Furnished Equipment (BFE), are included as Seller-Furnished Equipment (SFE) in this appendix.

## A. SELLER-FURNISHED EQUIPMENT

### 1. INSTRUMENTS

| ITEM | QUANTITY | DESCRIPTION |
|---|---|---|
| | | PROPULSION SYSTEM INSTRUMENTS |
| 1 | 4 | Indicator, Engine % RPM |
| 2 | 4 | Indicator, Engine Pressure Area Ratio |
| 3 | 4 | Indicator, Engine Oil Quantity |
| 4 | 4 | Indicator, Engine Oil Temperature |
| 5 | 4 | Indicator, Engine Oil Pressure |
| 6 | 4 | Indicator Light, Thrust Reverser Position and Warning |
| 7 | 4 | Indicator, Engine Vibration |
| 8 | 4 | Indicator, Engine RPM/EGT |
| 9 | 2 | Indicator Light, Master Fire Warning |
| 10 | 4 | Indicator Light, Fire Extinguisher Discharge |
| 11 | 1 | Indicator, Total Fuel |
| 12 | 12 | Indicator, Fuel Tank Quantity |
| 13 | 4 | Indicator, Fuel Flow Rate and Fuel Consumed |
| 14 | 1 | Indicator, Fuel Temperature |
| 15 | 4 | Indicator, Engine Inlet % Pressure Recovery |
| 16 | 4 | Indicator, Engine Exhaust Nozzle Area |
| 17 | 4 | Indicator, Engine Inlet Shock Position |
| 18 | 4 | Indicator and Control, Engine Inlet Spike Position |
| 19 | 4 | Indicator and Control, Engine Inlet Bypass % Open |
| 20 | 4 | Indicator, Engine Exhaust Gas Temperature |
| | | ELECTRICAL SYSTEM INSTRUMENTS |
| 21 | 1 | Voltmeter (a.c.) |
| 22 | 1 | Voltmeter (d.c.) |
| 23 | 4 | Watt-Var Meter |
| 24 | 1 | Frequency Meter |
| 25 | 1 | Ammeter (d.c.) |
| 26 | 1 | Indicator, Constant Speed Drive and Generator Oil Temperature |

## A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

### 1. INSTRUMENTS (Continued)

| ITEM | QUANTITY | DESCRIPTION |
|---|---|---|
| | | HYDRAULIC SYSTEMS (MAIN AND INLET) INSTRUMENTS |
| 1 | 7 | Indicator, Hydraulic Oil Pressure |
| 2 | 7 | Indicator, Hydraulic Oil Quantity |
| 3 | 2 | Indicator, Hydraulic Oil Temperature |
| 4 | 1 | Indicator, Hydraulic Brake Pressure |
| 5 | 2 | Indicator, Hydraulic Reservoir Pressure |
| | | FLIGHT INSTRUMENTS |
| | | Integrated Flight Control Instrument System |
| 6 | 2 | Indicator/Amplifier, Attitude Director |
| 7 | 2 | Indicator/Amplifier, Horizontal Situation |
| 8 | 1 | Display and Control Warning |
| 9 | 1 | Indicator, Standby Heading/Attitude |
| 10 | 2 | Display, Approach Progress |
| 11 | 2 | Indicator, Radio Altitude/Vertical Speed |
| | | Air Data System |
| 12 | 2 | Indicator, Pressure Altitude |
| 13 | 2 | Indicator, Calibrated Airspeed/Mach/Total Air Temperature |
| 14 | 1 | Indicator, Static Air Temperature/True Airspeed |
| 15 | 2 | Indicator, Indicated Airspeed |
| | | General |
| 16 | 2 | Clock, 3-inch, 12-hour |
| 17 | 1 | Clock, 2-inch, 12-hour |
| 18 | 1 | Indicator Light, Master Caution |
| 19 | 1 | Display, Wing Sweep and Flap Position |
| 20 | 1 | Display, Control Surfaces Position |
| 21 | 1 | Indicator, Pneumatic Brake Pressure |

A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

1. INSTRUMENTS (Continued)

| ITEM | QUANTITY | DESCRIPTION |
|---|---|---|
| | | FLIGHT INSTRUMENTS (Continued) |
| | | General (Continued) |
| 1 | 1 | System Annunciator, Pilots' |
| 2 | 1 | System Annunciator, Engineer's |
| 3 | 1 | Landing Gear Annunciator |
| | | ENVIRONMENTAL CONTROL INSTRUMENTS |
| 4 | 1 | Indicator, Oxygen Pressure |
| 5 | 1 | Indicator, Oxygen Quantity |
| 6 | 2 | Indicator, Temperature |
| 7 | 1 | Indicator, Ozone Concentration |
| 8 | 1 | Indicator, Cabin Rate of Climb |
| 9 | 1 | Indicator, Cabin Altitude |
| 10 | 1 | Indicator, Cabin Differential Pressure |
| 11 | 4 | Indicator, Air Flow |
| 12 | 1 | Indicator, Start Manifold Pressure |
| 13 | Reqd | Indicator, Valve Position |

## A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

2. PROPULSION

| ITEM | QUANTITY | DESCRIPTION |
|---|---|---|
| | | <u>PROPULSION</u> |
| 1 | 4 | Engine, including complete exhaust system, fuel control, pumps, and tachometer generator. Also, optional equipment, including oil and hydraulic fluid tanks |
| 2 | 4 | Inlet Assembly, Engine |
| 3 | 4 | Starter, Pneumatic |
| 4 | 4 | Fire Detector, Engine |
| 5 | 4 | Bottle, Fire Extinguisher (Bromotrifluoromethane) |
| | | <u>ACCESSORY DRIVE SYSTEM EQUIPMENT</u> |
| 6 | 4 | System, Accessory Drive Gear Box |
| 7 | 4 | Heat Exchanger Generator/Generator Drive (Oil/Fuel) |

A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

3. ELECTRICAL EQUIPMENT

| ITEM | QUANTITY | DESCRIPTION |
|---|---|---|
| | | ELECTRICAL EQUIPMENT |
| 1 | 4 | Generator, 40 kva, 115-volt, a.c. |
| 2 | 4 | Drive, Generator |
| 3 | 1 | Battery, 24-volt, Nickel-Cadmium |
| 4 | 4 | Unit, Transformer-Rectifier, d.c. Power |
| 5 | 1 | Unit, Transformer-Rectifier, Battery Charging |
| 6 | 4 | Power Control Assembly, Generator |
| 7 | 1 | Static Inverter |

A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

4. HYDRAULIC AND PNEUMATIC EQUIPMENT

| ITEM | QUANTITY | DESCRIPTION |
|---|---|---|
| | | HYDRAULIC EQUIPMENT |
| 1 | 6 | Pump, Engine Driven |
| 2 | 1 | Pump, Electric Motor Driven |
| 3 | 6 | Heat Exchanger, Hydraulic (Fluid/Fuel) |
| 4 | 4 | Reservoir, Hydraulic Fluid |
| 5 | 1 | Accumulator, Brake |
| 6 | 3 | Motor, Hydraulic, Wing Sweep |
| 7 | 1 | Package, Power Control, Rudder |
| 8 | 1 | Package, Power Control, Stabilizer |
| 9 | 12 | Package, Power Control, Aileron |
| | | PNEUMATIC EQUIPMENT |
| 10 | 1 | Cylinder, Gas Storage, Pneumatic Brake |

## A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

### 5. AVIONICS

| ITEM | QUANTITY | DESCRIPTION |
|---|---|---|
| | | <u>ENROUTE NAVIGATION</u> |
| | | <u>Inertial System</u> |
| 1 | 3 | Inertial Measuring Unit |
| 2 | 3 | Computer, Position and Course |
| 3 | 3 | Display Panel |
| 4 | 3 | Control Panel |
| 5 | 2 | Data Insert Panel |
| 6 | 3 | Converter Unit |
| 7 | 3 | Battery |
| 8 | 1 | Interface Box |
| 9 | 2 | Magnetic Azimuth Detector |
| 10 | 2 | Compensator |
| | | <u>Weather Radar System</u> |
| 11 | 1 | Transmitter-Receiver |
| 12 | 2 | Control Unit |
| 13 | 1 | Antenna |
| 14 | 2 | Display Indicator |
| 15 | 2 | Indicator Mount |
| 16 | 1 | Interface Box |
| 17 | 1 | Waveguide Assembly |
| 18 | 1 | Radome |
| | | <u>FLIGHT INSTRUMENTS</u> |
| | | <u>Radio Altimeter</u> |
| 19 | 2 | Receiver-Transmitter |
| 20 | 4 | Antenna |

## A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

5. AVIONICS (Continued)

| ITEM | QUANTITY | DESCRIPTION |
|---|---|---|
| | | FLIGHT INSTRUMENTS (Continued) |
| | | Integrated Flight Control Instrument System |
| 1 | 1 | Comparator and Approach Gate Monitor |
| 2 | 2 | Control Column Shaker |
| 3 | 2 | Angle-of-Attack Sensor |
| 4 | 2 | Flap Position Transducer |
| 5 | 1 | Stall Warning Control Unit |
| 6 | 1 | Interface Box |
| | | Air Data System |
| 7 | 2 | Computer Unit |
| 8 | 2 | Total Temperature Probe |
| 9 | 1 | Pitot-Static Probe - Dual (Nose) |
| 10 | 2 | Pitot Probe (Body) |
| 11 | 7 | Static Ports (Body) |
| 12 | 1 | Interface Box |
| 13 | 2 | Transmitter, Wing Sweep |
| 14 | 1 | Air Data Computer, Primary-Alternate Pitot-Static Selector |
| | | TERMINAL NAVIGATION |
| | | Automatic Direction Finder (ADF) |
| 15 | 2 | Receiver |
| 16 | 2 | Control Panel |
| 17 | 2 | Antenna Assembly, Loop and Sense |
| 18 | 2 | Coupler |
| 19 | 2 | Line Stretcher |
| 20 | 2 | Quadrant Corrector |

A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

5. AVIONICS (Continued)

| ITEM | QUANTITY | DESCRIPTION |
|---|---|---|
| | | TERMINAL NAVIGATION (Continued) |
| | | VOR/LOC/Glide Slope |
| 1 | 2 | Receiver VOR/LOC/GS |
| 2 | 2 | VOR/LOC/GS/DME/VHF Communications Control |
| 3 | 2 | VOR/Localizer Antenna |
| 4 | 1 | Glide Slope Antenna (Dual) |
| 5 | 1 | Interface Box, Navigation |
| | | DISTANCE MEASURING EQUIPMENT |
| 6 | 2 | Interrogator |
| 7 | 2 | Antenna |
| | | Marker Beacon |
| 8 | 1 | Receiver |
| 9 | 1 | Antenna |
| | | SHORT RANGE COMMUNICATION |
| | | VHF Communications |
| 10 | 2 | Transceiver |
| 11 | 2 | VHF Antenna |
| | | ATC Transponder |
| 12 | 2 | Transponder |
| 13 | 1 | Control |
| 14 | 2 | Antenna |
| 15 | 2 | Indicator, ATC Altitude |

## A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

5. AVIONICS (Continued)

| ITEM | QUANTITY | DESCRIPTION |
|---|---|---|
| | | SHORT RANGE COMMUNICATION (Continued) |
| | | Interphone System |
| 1 | 1 | Amplifier |
| 2 | 4 | Audio Select Panel |
| 3 | 2 | Cockpit Speaker |
| 4 | Reqd | Interphone Panel |
| | | Passenger Address |
| 5 | 1 | Amplifier |
| 6 | 1 | Control Panel |
| 7 | 1 | Music Tape Reproducer |
| 8 | 26 | Loudspeaker (8-inch) Passenger Cabin |
| 9 | 8 | Loudspeaker (4-inch) Lavatory and Galley |
| 10 | 2 | Microphone |
| | | LONG RANGE COMMUNICATION |
| | | HF Communications |
| 11 | 2 | Transceiver |
| 12 | 1 | Control Panel (dual) |
| 13 | 2 | Antenna Coupler |
| 14 | 2 | Coupler Control |
| 15 | 2 | Antenna |
| 16 | 1 | Lightning Arrestor |
| 17 | 1 | Antenna Switch |
| 18 | 1 | Interface Box |
| | | Selective Calling System |
| 19 | 1 | Decoder |
| 20 | 1 | Chime |
| 21 | 1 | Control |

## A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

5. AVIONICS (Continued)

| ITEM | QUANTITY | DESCRIPTION |
|---|---|---|
| | | RECORDER SYSTEMS |
| | | Flight Data Recorder System |
| 1 | 1 | Recorder Unit |
| 2 | 1 | Trip and Data Encoder |
| 3 | 1 | Normal Accelerometer |
| 4 | 1 | Foil Magazine |
| 5 | 1 | Sensor Unit |
| 6 | 1 | Spool and Tape |
| | | Flight Deck Voice Recorder |
| 7 | 1 | Voice Recording Unit |
| 8 | 1 | Microphone/Monitor Box |
| 9 | 1 | Tape Cartridge Assembly |
| | | AUTOMATIC FLIGHT CONTROL SYSTEM |
| 10 | 1 | Autopilot System (Dual) |
| 11 | 1 | Flight Director/Autopilot Mode Selector |
| 12 | 2 | Indicator Light, Autopilot Disengage |
| 13 | 2 | Indicator Light, Auto Throttle Disengage |
| | | STABILITY AUGMENTATION SYSTEM |
| 14 | 1 | Stability Augmentation System (Triple) |

A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

6. FURNISHINGS

| ITEM | QUANTITY | DESCRIPTION |
|---|---|---|
| | | CONTROL CABIN |
| 1 | 1 | Seat, Captain |
| 2 | 1 | Seat, First Officer |
| 3 | 1 | Seat, Flight Engineer |
| 4 | 1 | Seat, First Observer |
| 5 | 1 | Seat, Second Observer |
| | | PASSENGER CABIN |
| 6 | 72 | Seat, Double, Tourist Class |
| 7 | 12 | Seat, Triple, Tourist Class |
| 8 | 10 | Seat, Double, First Class |
| 9 | 200 | Belt, Passenger Seat |
| 10 | 2 | Seat, Double Attendant |
| 11 | 1 | Seat, Single Attendant |
| 12 | 5 | Harness, Attendant Seat |
| 13 | 3 | Galley (Including Service Equipment) |
| 14 | 6 | Compartment, Lavatory |
| 15 | 94 | Service Unit, Passenger |
| 16 | 1 | Tank, Water |
| 17 | 2 | Closet, Coat |
| | | OVERSEAS EMERGENCY EQUIPMENT |
| 18 | 9 | Raft, Life, 25-Man |
| 19 | 9 | Emergency Beacon, Automatic |
| 20 | 220 | Vest, Life |

A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

6. FURNISHINGS (Continued)

| ITEM | QUANTITY | DESCRIPTION |
|---|---|---|
| | | OXYGEN EQUIPMENT |
| 1 | 1 | Converter and Coil Assembly, Liquid Oxygen, 25-liter Capacity |
| 2 | 11 | Cylinder, Passenger, Portable (Including Mask) |
| 3 | 1 | Cylinder, Flight Crew, Portable |
| 4 | 5 | Mask, Flight Crew, Oronasal-Type |
| 5 | 4 | Goggles, Smoke |

A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

7. ENVIRONMENTAL CONTROL

| ITEM | QUANTITY | DESCRIPTION |
|---|---|---|
| | | CABIN AIR |
| 1 | 4 | Compressor, Air Boost |
| 2 | 4 | Air Cycle Machine |
| 3 | 4 | Heat Exchanger, Primary, Air/Air |
| 4 | 4 | Heat Exchanger, Secondary, Air/Fuel |
| 5 | 4 | Heat Exchanger, Primary, Air/Fuel |
| 6 | 4 | Heat Exchanger, Secondary, Air/Air |
| 7 | 4 | Heat Exchanger, Primary, Air/Air (Regenerative) |
| 8 | 1 | Pressure Controller, Automatic/Manual |
| 9 | 1 | Temperature Selector, Flight Deck |
| 10 | 1 | Temperature Selector, Passenger Cabin |
| | | ANTI-ICE AND RAIN PROTECTION |
| 11 | 4 | System, Engine Anti-ice |
| 12 | 2 | System, Windshield Anti-ice and Antifogging |
| 13 | 2 | System, Windshield Rain Repellent |

| | WEIGHT (POUNDS) |
|---|---|
| PROPULSION | |
| Engines - Boeing-Installed Weight (4) GE4/J5G, See. Par. 2.2.2 | 37,180 |
| LANDING GEAR | |
| Main | |
| Wheels | 1,550 |
| Tires | 1,870 |
| Brakes | 2,980 |
| Nose | |
| Wheels | 102 |
| Tires | 190 |
| Tail | |
| Wheels | 70 |
| Tires | 50 |
| ELECTRONICS | |
| Autopilot (Excluding Stability Augmentation System) (2) | 104 |
| Navigation System | 182 |
| Air Data System | 88 |
| Integrated Flight Control System | 105 |
| Weather Radar | 104 |
| Radio Altimeter | 26 |
| LF Automatic Direction Finding System (ADF) | 71 |
| VOR/Localizer/Glide Slope | 87 |
| Distance Measuring Equipment (DME) | 74 |
| Marker Beacon | 6 |
| ATC Transponder | 33 |
| Interphone | 10 |
| Passenger Address System | 71 |

| | WEIGHT (POUNDS) |
|---|---|
| ELECTRONICS (Continued) | |
| HF Communications | 259 |
| VHF Communications | 57 |
| Voice Recorder | 18 |
| Flight Data Recorder | 23 |
| Selective Calling System | 13 |
| FURNISHINGS | |
| Passenger Seats (Excluding Belts) | |
| First Class Double (10) | 360 |
| Tourist Double (72) | 2592 |
| Tourist Triple (12) | 648 |
| Carpeting, Passenger Compartment | |
| Including pad (55 ounces per square yard) | 630 |

# SUPPLEMENT 1
# Prototype Specification

CONTENTS

CONTENTS (Cont)

CONTENTS (Cont)



ILLUSTRATIONS

## INTRODUCTION

This supplement describes the current Boeing Model 733 preproduction prototype supersonic transport.

The Model 733 supersonic transport prototype is designed to demonstrate the feasibility of the production supersonic transport as a commercial passenger/cargo airplane. It is further intended that the design of the Model 733 prototype be as similar as practical to that of the initial commercial production aircraft. The Model 733 supersonic transport prototype design and test program includes the following specific objectives:

- Confirm that airline standards of safety, economics, and reliability are attainable.
- Provide a base for developing production tooling, fabrication methods, and an assembly plan that will optimize production schedules and minimize costs.
- Demonstrate airplane performance, flight characteristics, systems, and structural capabilities to representatives of U.S. Government, airlines, airport operators, and financial agencies.
- Provide means to further improve and develop SST technology, safety, economics, and equipment.
- Provide a base for developing an efficient supplier program for airplane component and equipment items.
- Utilize Boeing subsonic commercial jet airplane experience and SST technology available in the United States, where appropriate, in SST design.
- Provide a base for developing ground servicing, maintenance, operation, and training requirements.

To provide a representative test airplane, the preproduction prototype is designed to have the same aerodynamic configuration and size as the basic production airplanes. Preflight rating test (PFRT) engines of the type planned for production installation will be used on the prototype. The prototype airplane will be capable of flying at a maximum operating Mach number ($M_{MO}$) of 2.7 and total stagnation temperature of 500°F

for a sufficient period of time to establish steady state temperature conditions. The foregoing maximum operating Mach number and total stagnation temperature are the same as those required for the production aircraft. All systems described will be evaluated during the 100-hour flight program although certain items may not be installed and/or operable for a specific flight. The airplane configuration for any specific flight shall be separately documented. The test equipment to be installed in the prototype airplane for the flight test program and the test plan shall be separately documented.

Changes from approved specifications in order to maintain schedule, performance, or cost will be governed by established configuration management procedures.

The definition of the preproduction prototype airplane contained in this supplement has been prepared in the form of a change list in order to provide a compact summary of the differences between the production and prototype airplanes.

Entries in this supplement are identified by the same chapter and paragraph number under which each subject item appears in the basic portion of Model Specification D6-17850. Where no entry is made in this Supplement for a specific paragraph of the basic Model Specification, the entire paragraph shall be applicable to the prototype airplane. Where any portion of any chapter or paragraph of the basic Model Specification is inapplicable to the prototype airplane, this chapter or paragraph is replaced, revised, or deleted. Deletion of a principal chapter or paragraph heading shall include deletion of all subparagraphs thereunder without individual notation of deletion for each subparagraph.

## 1.0 GENERAL AIRPLANE DESCRIPTION

1.2 TYPE AND PURPOSE

Change to Read:

The airplane shall be a preproduction prototype of a four-engine, land-based, supersonic airplane for commercial transportation of passengers and cargo. The airplane shall, within practical and economic limits, be representative of the initial production airplane and suitable for supporting the certification of the production airplane.

1.3 SELLER'S NAME AND MODEL NUMBER

Change to Read:

Boeing Model 733 Prototype.

1.4.2 Delete

1.5.1 Crew

Change to Read:

Captain
First Officer
Flight Engineer
Observers (2)
Cabin Attendant (1)
Flight Test Observers (As Required)

1.5.2 Passengers (Basic Intercontinental Arrangement)

Change to Read:

Passengers

Accommodations for approximately 50 passengers shall be provided.

1.5.3 Cargo

Change to Read:

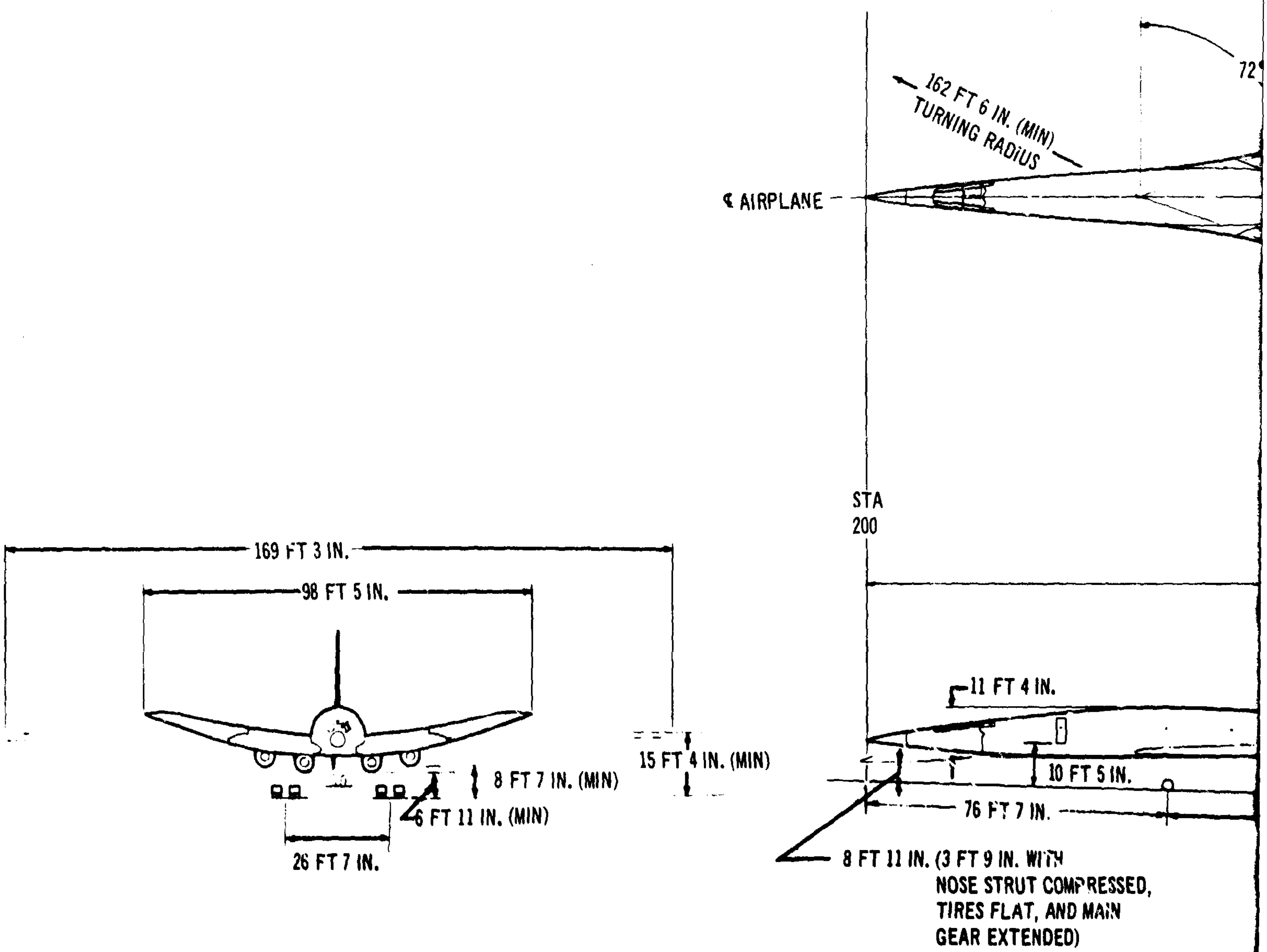
| | Approximate Usable Volume (Cu. Ft.) |
|---|---|
| Upper Compartment (Class D) | 718* |
| Lower Compartment (Class D) | 537 |
| Total | 1255 |

*Only internal access provided

Volumes quoted may not be available due to installation of test equipment.

Figure 1-1 Replace this figure with Figure S1.1-1.

Figure 1-2 Replace this figure with Figure S1.1-2.


72°
162 FT 6 IN. (MIN)
TURNING RADIUS
℄ AIRPLANE
STA
200
169 FT 3 IN.
98 FT 5 IN.
15 FT 4 IN. (MIN)
8 FT 7 IN. (MIN)
6 FT 11 IN. (MIN)
26 FT 7 IN.
11 FT 4 IN.
10 FT 5 IN.
76 FT 7 IN.
8 FT 11 IN. (3 FT 9 IN. WITH
NOSE STRUT COMPRESSED,
TIRES FLAT, AND MAIN
GEAR EXTENDED)

A

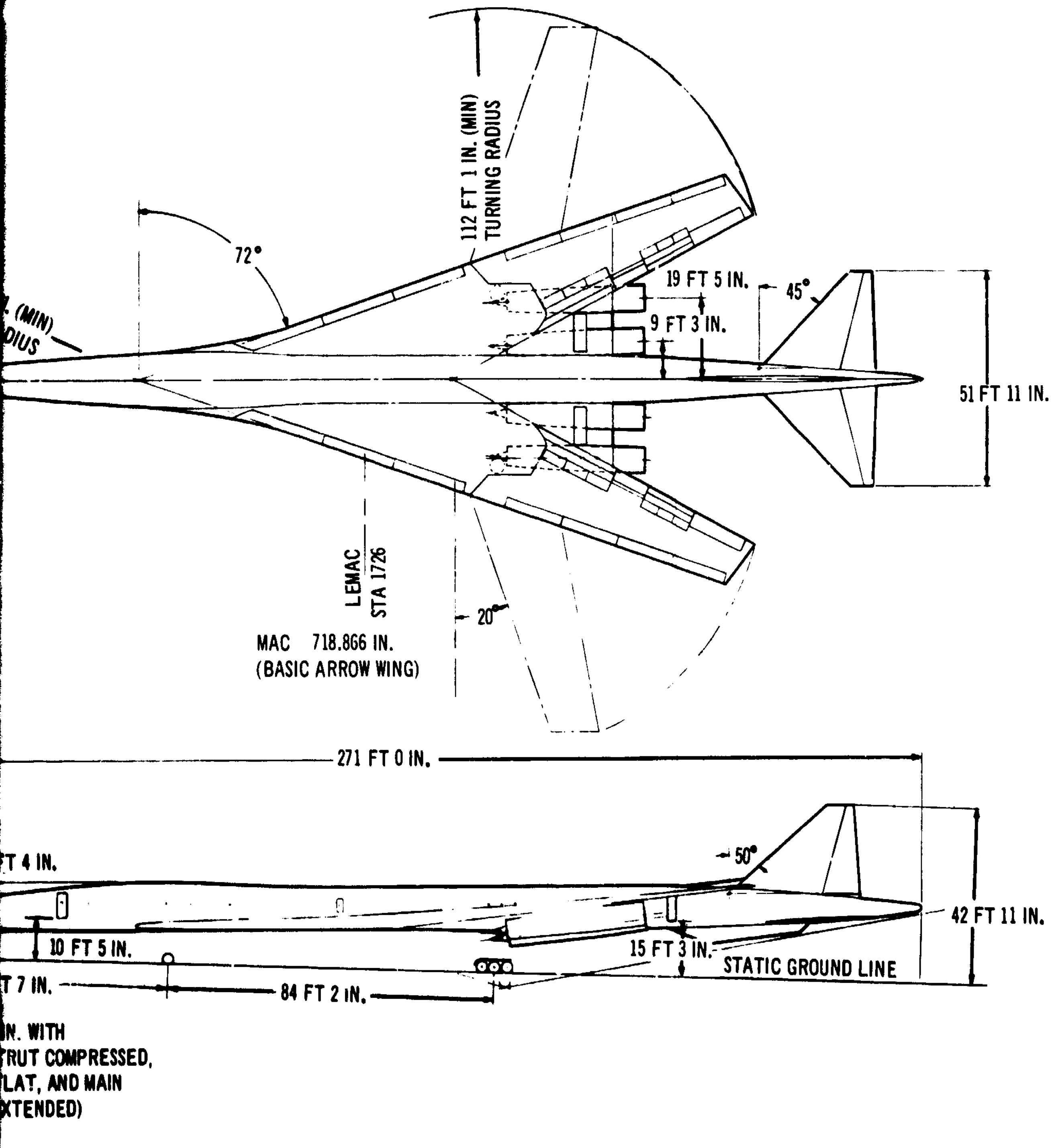
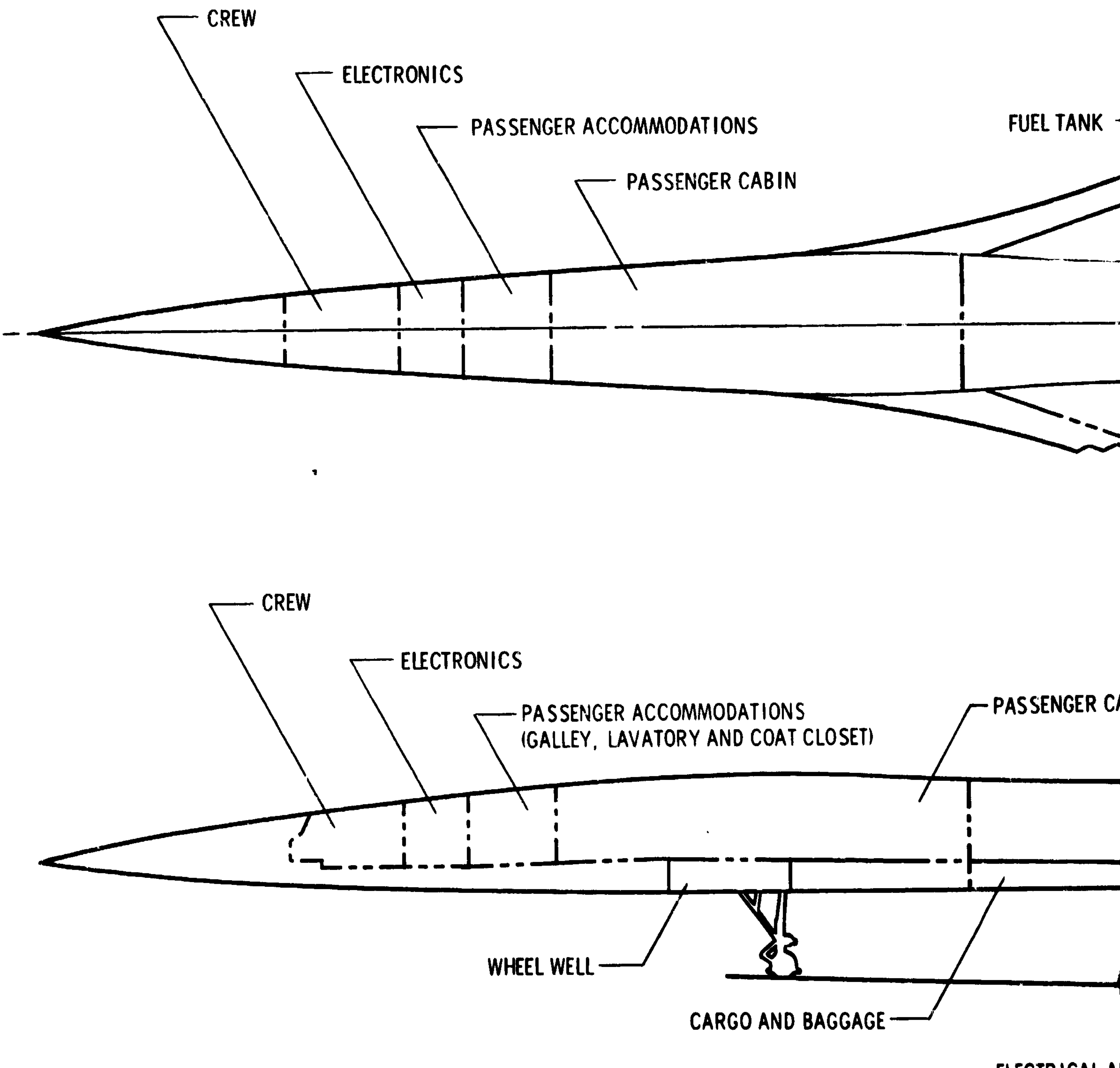


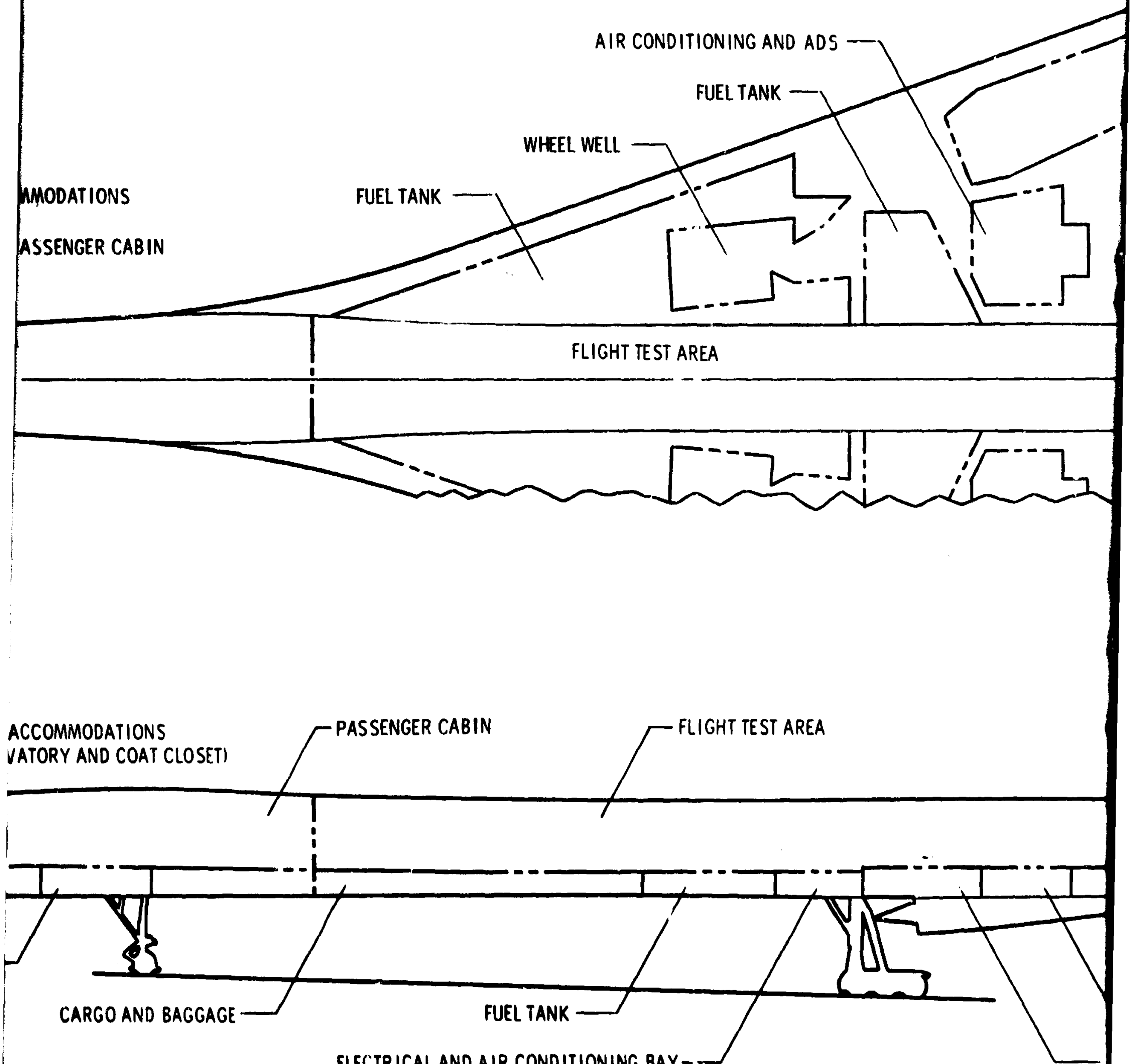

*Fig. S1.1-1 General Arrangement – Model 733 Preproduction Prototype*



B


CREW
ELECTRONICS
PASSENGER ACCOMMODATIONS
PASSENGER CABIN
FUEL TANK
CREW
ELECTRONICS
PASSENGER ACCOMMODATIONS
(GALLEY, LAVATORY AND COAT CLOSET)
PASSENGER CA
WHEEL WELL
CARGO AND BAGGAGE
ELECTRICAL AN

A


AIR CONDITIONING AND ADS
FUEL TANK
WHEEL WELL
MMODATIONS
FUEL TANK
ASSENGER CABIN
FLIGHT TEST AREA
ACCOMMODATIONS
VATORY AND COAT CLOSET)
PASSENGER CABIN
FLIGHT TEST AREA
CARGO AND BAGGAGE
FUEL TANK
ELECTRICAL AND AIR CONDITIONING BAY

B

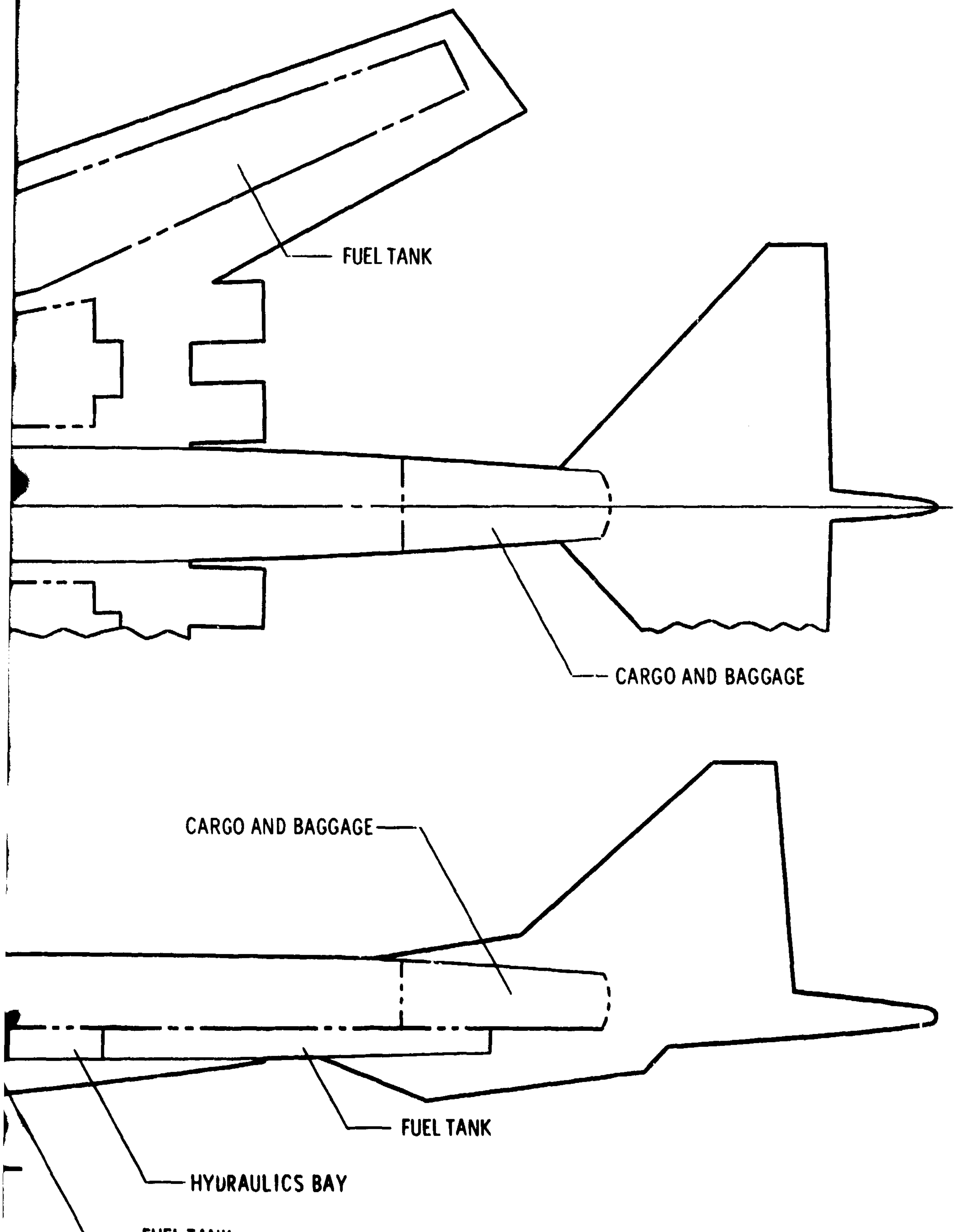



*Fig. S1.1-2 Inboard Profile*

C

## 2.0 GENERAL REQUIREMENTS

2.1 PURCHASE AGREEMENT GOVERNS

Change to Read:

CONTRACT GOVERNS

In the event of any conflict or discrepancy between this specification and the contract, the terms in the contract shall govern.

2.2.2 Supplemental Specifications

Change to Read:

- General Specifications
  - Engine Manufacturer's Specification (Subject to future determination)
  - Electronic Systems and Optional Equipment List
  - Electrical Interference Controls Requirements, Electrical and Electronic Equipment
  - Interior Colors and Materials, D6-6908
  - Galley Design and Installation Specification, D6-6954
  - Passenger Seat Design Criteria, D6-2556
  - Exterior Decorative Markings Specification, D6-6956
  - Protective Finishes

- **Systems Performance Specifications**

  **The following systems performance specifications apply only to the prototype airplane and define system objectives rather than firm requirements.**

  - **Inlet Control System Performance Specification, D6-19905**
  - **Propulsion System Performance Specification, D6-19906**
  - **Power Plant Installation Performance Specification, D6-19907**
  - **Propulsion Controls Performance Specification, D6-19908**

- Air Induction System Performance Specification, D6-19909
- Accessory Power Drive System Performance Specification, 10-61105
- Air Turbine Drive and Starter Performance Specification, 10-61109
- Electric Power System Performance Specification, D6-16330
- Engine Inlet Anti-Icing Performance Specification, D6-16327
- Environmental Control System Performance Specification, D6-17853
- Hydraulic System Performance Specification, D6-17854
- Automatic Flight Control System Performance Specification, D6-17855
- Fuel System Performance Specification, D6-17856
- Fire Detection and Extinguishing System Performance Specification, D6-17857
- Communication Equipment Performance Specification, D6-17863
- Radio Navigation Equipment Performance Specification, D6-17864
- Inertial Navigation System Performance Specification, D6-17865
- Weather and Mapping Radar Performance Specification, D6-17866
- Flight Instrumentation Performance Specification, D6-17867
- Air Data System Performance Specification, D6-17868
- Wheels, Brakes and Tires, 10-

2.3.1 General

Change to Read:

It shall be the intent to design the prototype airplane in conformance with FAR 25, insofar as practicable (See Par. 3.1). During the prototype supersonic transport program, continuous liaison with the FAA shall be maintained to

develop rule changes to and interpretation of FAR 25. Although certification of the prototype for commercial operation is not contemplated, substantiating data shall be accumulated and coordinated with the FAA to obtain certification of the production Model 733 in the most efficient manner.

2.3.2 Delete

2.4.2 Master Changes
Change to Read:
Changes

Changes that are variations from the airplane described in this specification shall be defined and processed as outlined in D6-17613, Configuration Management Plan.

2.4.3 Delete

2.4.4 Delete

2.4.5 Delete

2.5 WORKMANSHIP, MATERIALS, AND METHODS
Change to Read:

Workmanship, materials, and methods, substantially in accordance with the Seller's standard for airplanes of the transport category, shall be used in the construction of the aircraft.

2.6 INSPECTION AND TESTS

Change to Read:

An accurate and complete system of inspection covering all materials, fabrication methods, and finished parts shall be maintained by Boeing. Inspection and testing of materials, or parts shall be in accordance with procedures established by Boeing.

2.7 Delete

2.9 MOCKUPS

Change to Read:

Mockups requested by the Procuring Agency, which are additional to those required by the Seller, may be constructed by the Seller when agreed to by change order to the contract or by separate written agreement between the Procuring Agency and Seller.

2.10 BUYER-FURNISHED EQUIPMENT

Change to Read:

EQUIPMENT FURNISHED BY PROCURING AGENCY

The contract defines the obligations of the Procuring Agency and Seller concerning equipment to be furnished by the Procuring Agency for installation in the airplane. See Appendix I.B for a listing of such equipment.

2.12.1 Seller's Name

Change to Read:

The Seller's name, model number, and exterior markings shall be displayed on the outside of the airplane.

2.13 CERTIFICATE OF SANITARY CONSTRUCTION

Change to Read:

The requirements set forth in Public Health Service Bulletin 308 shall be used as a design guide. However, a certificate of sanitary construction, issued by the U.S. Public Health Service, shall not be obtained for the airplane.

2.14.1 Terms and Abbreviations

Change to Read:

The terms and abbreviations defined below shall have the meanings specified in this paragraph wherever used in this Specification:

"FAA" shall mean the regulatory branch of the United States Federal Aviation Agency

"FAR" shall mean the Federal Air Regulations promulgated by the United States Federal Aviation Agency

"NASA" shall mean the National Aeronautics and Space Administration

"Boeing" or "Seller" shall mean The Boeing Company

"Procuring Agency" shall mean the procuring agency of the U.S. Government for the airplane(s) described in this Specification

"Contract" shall mean the contract between Boeing and the Procuring Agency relating to the design, fabrication, and testing of the airplane(s) described in this Specification

"Standard Day" shall mean U.S. Standard Atmosphere, 1962

"ARINC" shall mean Aeronautical Radio, Inc.

"SAE" shall mean Society of Automotive Engineers

"ATA" shall mean Air Transport Association

"AIA" shall mean Aerospace Industries Association of America, Inc.

"ASTM" shall mean American Society for Testing Materials

## 3.0 GENERAL AIRPLANE CHARACTERISTICS

3.3 DESIGN BALANCE LIMITS

Change to Read:

The center-of-gravity limits (percent of MAC with wings in 72-degree sweep position) shall be substantially as shown in Fig. 3-2. Center-of-gravity position for Operational Empty Weight shall be approximately _____ percent MAC with wings in 20-degree sweep position, gear down.

3.10 Delete

# 4.0 AIRFRAME STRUCTURES

4.1.1 Service Life

Change to Read:

A service life of not less than 50,000 flight hours shall be the criteria to which the primary structure of the airplane is designed. Substitution of processes, designs, and/or materials to meet program requirements may affect prototype service life. Because of calendar time required for Seller's SST structural test program, some of the resulting development may not be incorporated in the prototype.

4.4.3.2 Passenger Cabin Floor

Change to Read:

Cabin Floor

The passenger cabin floor arrangement shall provide for track-mounted passenger seats in the passenger area and for track mounting of test equipment and/or seats in the area aft of the passenger area. The tracks shall be flush with the floor and shall provide for seat location and test equipment adjustment in increments of 1 inch fore and aft.

4.4.5.3 Galley Service Door

Change to Read:

One plug-type galley service door, approximately 30 inches wide and 60 inches high shall be provided in the passenger area. The door shall be located on the right side of the airplane.

4.4.5.4 Cargo Doors

Change to Read:

A door shall be provided in the forward partition of the aft cargo compartment to permit access to this compartment. Three external doors, two approximately 36 inches long and 30 inches wide, and one approximately 36 inches long and 48 inches wide, shall be provided in the lower cargo compartment.

4.4.5.5 Emergency Exits

Change to Read:

Two plug-type emergency exits, each approximately 20 inches wide and 38 inches high shall be provided in the cabin area. The exits shall be located (one on each side of the body) over the wing.

Two plug-type emergency exits shall be provided in the flight deck. The left hand exit shall be hinged to permit its use for ground communication and ventilation.

A crew inflight escape device consisting of an egress chute with spoiler door shall be provided adjacent to the flight deck area.

4.4.5.9 Lock Indicators

Change to Read:

Indicators located in the flight deck area shall be provided to warn when any of the following doors are not closed and locked: main entry doors, galley service door, landing gear doors, and crew egress chute/spoiler door.

## 5.0 PROPULSION

5.1.2 Maintainability

Change to Read:

During design, special attention shall be given to the ease with which components can be inspected, maintained, repaired and replaced. The inlet and exhaust systems will be designed to permit their removal or installation without removing the engines from the airplane.

5.1.3 Interchangeability

Change to Read:

It shall be a design objective that common parts and assemblies subject to removal from the engine for routine maintenance be made interchangeable or replaceable-interchangeable. It shall be a design objective to make each propulsion pod interchangeable between pod positions and airplanes.

6.1.5 Placards and Signs

Change to Read:

Placards and signs on the flight deck shall be in the English language.

6.2.1 Pilots' Seats

Change to Read:

The captain's seat shall be reclinable and adjustable vertically and fore and aft; it shall be power operated fore and aft to facilitate monitoring the flight engineer's panel. The first officer's seat shall be reclinable and adjustable vertically, laterally, and fore and aft. Folding armrests to facilitate entry into the seats shall be provided. The pilots' seats shall be designed to accommodate a "back-pack" parachute.

6.2.2 Flight Engineer's Seat

Change to Read:

The flight engineer's seat shall swivel and be adjustable vertically, laterally, and fore and aft. It shall be power operated fore and aft to facilitate coordination with the pilots. The flight engineer's seat shall be designed to accommodate a "back-pack" parachute.

6.3.3 Escape Facilities

Change to Read:

Two emergency exits, with escape ropes attached to airplane structure, shall be provided in the flight deck area. An inflight escape device shall also be provided adjacent to the flight deck area (see Par. 4.4.5.5).

## 7.0 FLIGHT CONTROLS

No changes made.

## 8.0 HYDRAULIC AND PNEUMATIC POWER SYSTEMS

No changes made.

## 9.0 ELECTRIC POWER SYSTEM

9.2.1 General

Change to Read:

General airplane interconnecting wiring, shielded and unshielded, shall comply with applicable Boeing material specifications. Wiring shall be compatible with the electrical load requirements and the environment of the area in which it is installed.

Miniaturized plastic insulated wire or multiconductor cable may be used for interconnecting wiring, but shall be no smaller than Size 24 except where mechanical strength is not limiting. Individually shielded wire shall be used as needed in sensitive circuits to meet standard performance requirements.

9.3.1 General

Change Last Paragraph to Read:

Interference exceeding the preceding limits caused by equipment furnished by the Procuring Agency that does not meet the susceptibilit or interference generation requirements of the applicable Boeing document cited in Par. 2.2.2 shall be the responsibility of the Procuring Agency.

9.6 STANDBY POWER

Change to Read:

Nickel-cadmium battery (batteries) shall be installed. Adjacent structure shall be protected against fumes and spilled electrolyte. A battery charger shall be installed. Relaying shall be incorporated to prevent battery discharge through the normal d.c. bus. A battery control switch shall

be provided on the flight engineer's panel. A static inverter capable of supplying all a.c. loads required for limited subsonic flight and emergency communications/navigation shall be installed as a standby source for a.c.

9.11.1 General

Change to Read:

All lighting shall be powered by a.c. power except for the emergency lighting, which shall use self-contained batteries. Bulb replacement shall be possible with common hand tools. Spare bulb stowage shall be provided. Single-contact bulbs shall be used wherever practicable.

All lighting except that of the test area shall be representative of that planned for the production airplane in regard to quality, illumination level, and decorative finish. The lighting in the test areas shall be sufficient to meet the requirements of the test program.

9.11.3 Passenger Cabin Lighting

Change to Read:

Cabin Lighting

A reading light and control switch shall be provided for each passenger seat. The design shall permit adjustment of the reading light for optimum position.

General illumination of the cabin (including the test area) shall be provided by incandescent lights. Controls for the cabin lights shall be at the attendants' panel.

The lavatory shall be illuminated by mirror lights. When not in use, the lavatory shall be illuminated by a low intensity bulb. Upon actuation of the sliding door lock,

the mirror light shall illuminate. Means shall be provided to energize all lavatory lights for maintenance purposes.

The galley shall have lights to illuminate the working area. The control shall be located at the attendants' panel.

The forward main entry doorway shall be provided with a light suitable for checking passenger lists and a door threshold light, both controlled by a switch at the attendants' control panel. The entry area lights shall be operable when power is connected to the external power receptacle, regardless of the position of the external power control switch on the flight engineer's panel.

NO SMOKING and FASTEN SEAT BELT signs shall be installed in view of the passengers and test area personnel. A RETURN TO SEAT sign shall be installed in the lavatory. An OCCUPIED indication sign shall be provided for the lavatory. A switch for the NO SMOKING and a switch for the FASTEN SEAT BELT and RETURN TO SEAT signs shall be located on the pilots' overhead panel.

9.12 SERVICE OUTLETS

Change to Read:

The galley shall be serviced by 12 kilowatts of 3-phase, 400-cps, 115/200-volt a.c. power. This service shall be controlled by a switch at the flight engineer's station.

The lavatory shall be provided with one 115-volt d.c. outlet for electric razors and one 28-volt d.c. razor outlet.

Outlets, providing 115 volts of 400-cps a.c. power, shall be installed at the electrical and electronic equipment racks and in the flight deck area for test equipment. Four convenience outlets each capable of supplying 1000 watts of 115-volt, 400-cps power, shall be provided in the cabin.

9.13.1 Attendants'

Change to Read:

Attendants' and Flight Test Area Personnel

An attendants' and flight test area personnel call system shall be installed and shall operate as follows:

One master call annunciator light fixture shall be installed in the passenger area ceiling. Separate colored lights shall indicate calls from the flight crew, lavatory, passenger area, or flight test area. A call button shall be installed in the lavatory, in the flight deck area, in the flight test personnel area, and on each passenger service unit. Actuation of the passenger service unit call button shall illuminate a light at the seat and the applicable master light. Resetting the passenger service unit light shall be accomplished at the unit. The master light shall extinguish when all seat lights have been reset. The lavatory call light shall be reset at the attendants' control panel. The flight-crew-to-attendant call shall illuminate the applicable master call light. A call button shall be provided at the attendants' station that shall operate a single-stroke tone and light in the flight deck area. Actuation of the call button in the flight test personnel area shall operate a single-stroke tone, a light in the flight deck area, and a light on the passenger area master annunciator light fixture.

## 10.0 AVIONICS

10.1.1 Installation

Change to Read:

Due to the fact that the equipment planned for the production airplane may not be available during the prototype program, current state-of-the-art electronics equipment may be installed.

10.5.3 Interphone System

Change to Read:

Flight and service interphone systems shall be installed.

The flight interphone section of the system shall provide for communication between the flight crew, cabin attendants and flight test area personnel.

The service interphone section of the system shall provide for communication between:

- Flight crew
- Cabin attendants
- Flight test area
- Electronics equipment area
- Nose wheel well
- Fueling stations

A two-position toggle switch shall be installed on the flight engineer's panel to disconnect the service section of the interphone from the flight section.

Audio selector panels shall be located at the captain's, first officer's, flight engineer's, and forward observer's stations.

Interphone panels shall be located at the cabin attendant's station, flight test personnel area, electronics equipment area, nose wheel well, and fueling station.

The interphone amplifier shall be located in the electronics equipment area.

Handsets shall be installed at the cabin attendant's station and in the flight deck area.

Headphones, boom microphones, oxygen mask microphones, and stowage provisions shall be installed at the captain's, first officer's, flight engineer's, and first observer's stations. Microphone selector switches shall be provided. Headphones, boom microphones, and stowage provisions shall be provided in the flight test personnel area stations.

Two-position, push-to-talk switches for interphone and air-to-ground communications shall be installed on the outboard horns of the pilot's control sticks and on the side panels. A MAINTAINED position shall be provided on each switch to permit interphone communication to be maintained without the necessity for the pilot's hand to remain on the switch. Push-to-talk switches shall be provided at the flight observer's stations.

Loudspeakers audible at the pilots' seated positions shall be installed in the flight deck area. (See Par. 10.5.4.)

10.5.4 Passenger Address System

Change to Read:

A passenger address system shall be installed to provide voice and music reproduction in the passenger and flight test area. Means shall be provided to disconnect the music function from the flight test area.

A transistorized noise cancelling microphone shall be installed at the cabin attendant's station. The pilots shall have priority over the cabin attendant in the use of the passenger address system.

Loudspeakers in the passenger and flight test areas of the cabin shall be located as necessary to provide essentially uniform sound distribution. A loudspeaker shall be installed in the lavatory. Cabin-attendant-initiated passenger address system announcements may be monitored by the flight crew through the interphone loudspeakers. (See Par. 10.5.3.)

## 11.0 PASSENGER AND CARGO PROVISIONS

11.1 GENERAL

Change to Read:

The cabin arrangement shall be substantially as shown in Fig. S1.11-1. The cabin shall be separated into two distinct areas, a passenger area and a flight test area. The passenger area shall be representative of the production airplane design, equipment, finish, and decor. (For drainage and ventilation information, see Par. 4.1.4.)

11.2.1 Cabin Attendants' Accommodations

Change to Read:

The cabin attendants' station shall be located substantially as shown in Fig. S1.11-1. The two-place attendants' seat shall automatically return to the folded position when unoccupied. Seat harnesses shall be provided for the attendants' seat. The attendants' panel (Fig. S1.11-2) shall be located near their seated station. One fixed service unit containing one work light and oxygen masks shall be installed at the attendants' station.

11.2.2 Passenger Accommodations

Change to Read:

The passenger area arrangement shall provide accommodations for approximately 50 passengers. A typical arrangement is shown in Fig. S1.11-1.

11.2.2.1 Delete

11.2.2.2 Delete

11.2.5 Lavatory Compartments

Change to Read:

Lavatory Compartment

A lavatory shall be provided and located substantially as shown in Fig. S1.11-1.

Lavatory Equipment

The lavatory shall include the following equipment:

- Toilet, toilet seat, and cover
- Wash basin (cold water service only provided)
- Soap dispenser
- Ash tray
- Air sickness bag dispenser
- Toilet tissue dispenser
- Toilet seat cover dispenser
- RETURN TO SEAT sign
- NO SMOKING sign
- Sanitary napkin dispenser
- Call button
- 115-volt d.c. and 28-volt d.c. shaver outlet
- Used towel disposal
- Tissue dispenser
- Paper towel dispenser
- Paper cup dispenser
- Used razor blade disposal
- Air sickness bag and sanitary napkin disposal
- Mirror
- Assist handle

The toilet seat and cover, faucet hardware, and wash basin lever-operated stopper shall be standard commercially available parts.

11.2.6 Galleys

Change to Read:

Galley

A galley unit shall be located substantially as shown in Fig. S1.11-1 and shall conform to the requirements of the "Galley Design and Installation Requirements" specification listed in Par. 2.2.2.

The galley unit shall be designed to the following ultimate load factors acting separately: upward, 4.5g; downward, 7.5g; forward, 9.0g; sideward, 3.0g. These load factors shall be multiplied by 1.33 for the design of fittings that attach the galley to the airplane structure. Galley mounting provisions shall be adequate for a 700-pound galley unit under 12g deceleration loads.

Electrical power for the galley unit shall enter the galley envelope at the bottom. Access to the disconnect fittings shall be provided through the bottom galley structure (see Par. 9.13).

11.2.7 Water System

Change to Read:

Potable drinking water shall be provided in the lavatory compartment and in the galley.

11.2.7.1 Delete

11.2.7.2 Delete

11.2.7.3 Delete

11.2.8 Stowage
Change to Read:

A literature container shall be provided for each seat. Stowage shall be provided in the passenger area for stowage of blankets, pillows, coats, etc.

11.2.10 Delete

11.2.14 Passenger Signs and Placards
Change to Read:

All signs and placards shall be in the English language. Illuminated NO SMOKING, FASTEN SEAT BELT, RETURN TO SEAT, and EMERGENCY EXIT signs shall be provided (see Par. 9.11.3). Self-illuminated EXIT signs shall be provided in the ceiling above the center aisle at the emergency exits.

Add Following Paragraph:
11.2.15 Flight Test Area

The flight test area (see Fig. S1.11-1) shall be finished essentially in the same manner as the passenger area except that no seats, passenger service units, lavatories, or galleys shall be provided.

11.3 CARGO COMPARTMENTS
Change to Read:

Two cargo compartments shall be located in the airplane substantially as shown in Figs. S1.11-4 and S1.11-5. The compartments shall be lined with high impact resistant material representative of that planned for the production airplane.

For fire protection, the cargo compartments shall be designed as Class D.

The aft cargo compartment shall be accessible from inside the airplane only.

Provisions for cargo and baggage retention shall be installed in both cargo compartments.

11.4.6 Life Rafts and Automatic Emergency Beacons

Change to Read:

Four 25-man life rafts shall be stowed in locations as shown in Fig. S1.11-6. An automatic emergency beacon shall be provided with each raft.

11.4.7 Life Jackets

Change to Read:

One life jacket shall be provided for each passenger seat and each of the flight test area personnel. In addition, two life jackets shall be installed under the forward attendants' seat.

11.5 OXYGEN SYSTEM

Change to Read:

An oxygen system shall be installed to provide oxygen for the passengers and flight test area personnel during an emergency descent and for sustaining flight following a decompression. The oxygen supply shall be of the production airplane design capable of providing sufficient oxygen for 215 passengers and for five cabin attendants for 100-percent usage during an emergency descent from cruise altitude to 14,000 feet, and for use by 10 percent of the passengers for

a period of 3 hours at a cabin altitude of 14,000 feet. The system shall be substantially as shown in Fig. S1.11-7. (See Par. 6.4 for flight crew oxygen system description.)

A 25-liter-capacity liquid oxygen converter and evaporation coil assembly that includes an overboard discharge line from the converter safety valve shall be installed. Two continuous-flow control units, each with an automatic actuating device, shall be provided.

The system shall be automatically actuated at cabin altitudes above approximately 14,000 feet. This shall include automatic presentation of the passenger, flight test area personnel, and cabin attendant oxygen masks. A warning light at the flight engineer's station shall indicate actuation of the system. In case of failure of the automatic actuating device, electrical actuation of the system shall be possible by a switch on the flight engineer's panel. System standby actuation shall be by manual operation of the control valve.

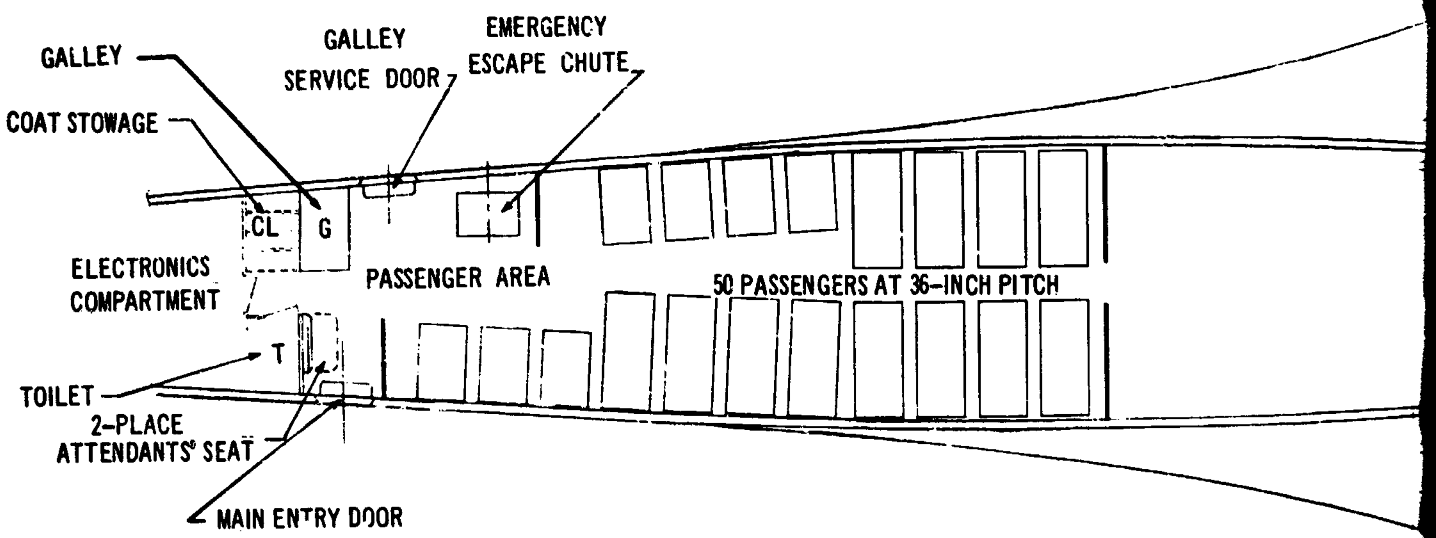
A combination fill-vent-buildup valve and drain valve shall be provided. A remote reading quantity indicator shall be located on the flight engineer's panel.

Tubing to the passenger service unit connectors shall be aluminum alloy. Flareless tube fittings shall be used throughout the system.

Four oxygen masks shall be provided in each passenger service unit serving three seats, and three masks shall be provided in each passenger service unit serving two seats. Two oxygen masks shall be installed in the lavatory service unit, galley work area, and cabin attendants' service unit.

The oxygen system manifolds shall also be provided in the flight test area. Oxygen masks shall be provided for personnel using this area.

| | |
|---|---|
| Figure 11-1 | Replace this figure with Figure S1.11-1 |
| Figure 11-2 | Replace this figure with Figure S1.11-2 |
| Figure 11-3 | Delete |
| Figure 11-4 | Replace this figure with Figure S1.11-4 |
| Figure 11-5 | Replace this figure with Figure S1.11-5 |
| Figure 11-6 | Replace this figure with Figure S1.11-6 |
| Figure 11-7 | Replace this figure with Figure S1.11-7 |


GALLEY
COAT STOWAGE
GALLEY SERVICE DOOR
EMERGENCY ESCAPE CHUTE
CL
G
ELECTRONICS COMPARTMENT
PASSENGER AREA
50 PASSENGERS AT 36-INCH PITCH
T
TOILET
2-PLACE ATTENDANTS' SEAT
MAIN ENTRY DOOR

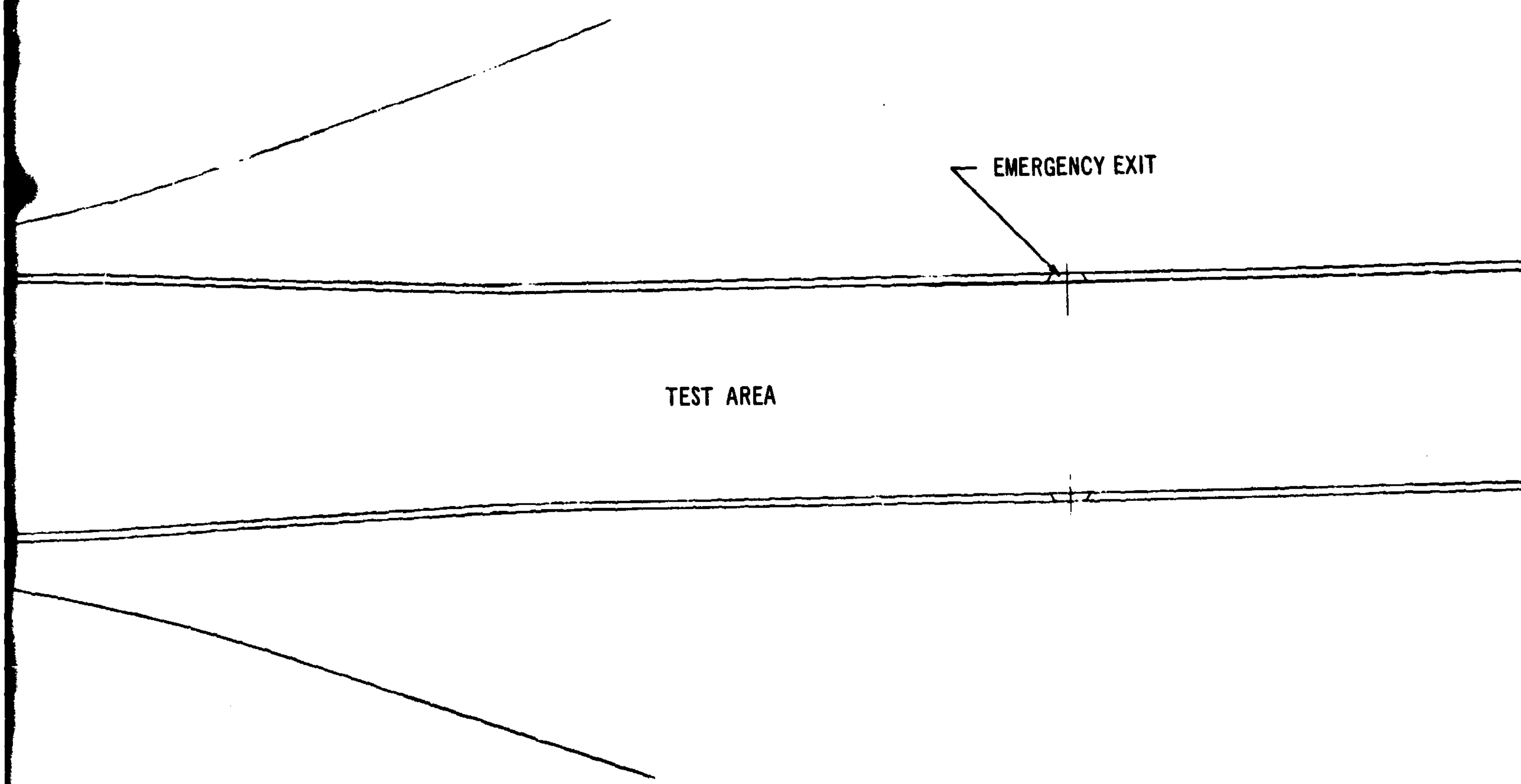



Fig. S1

B

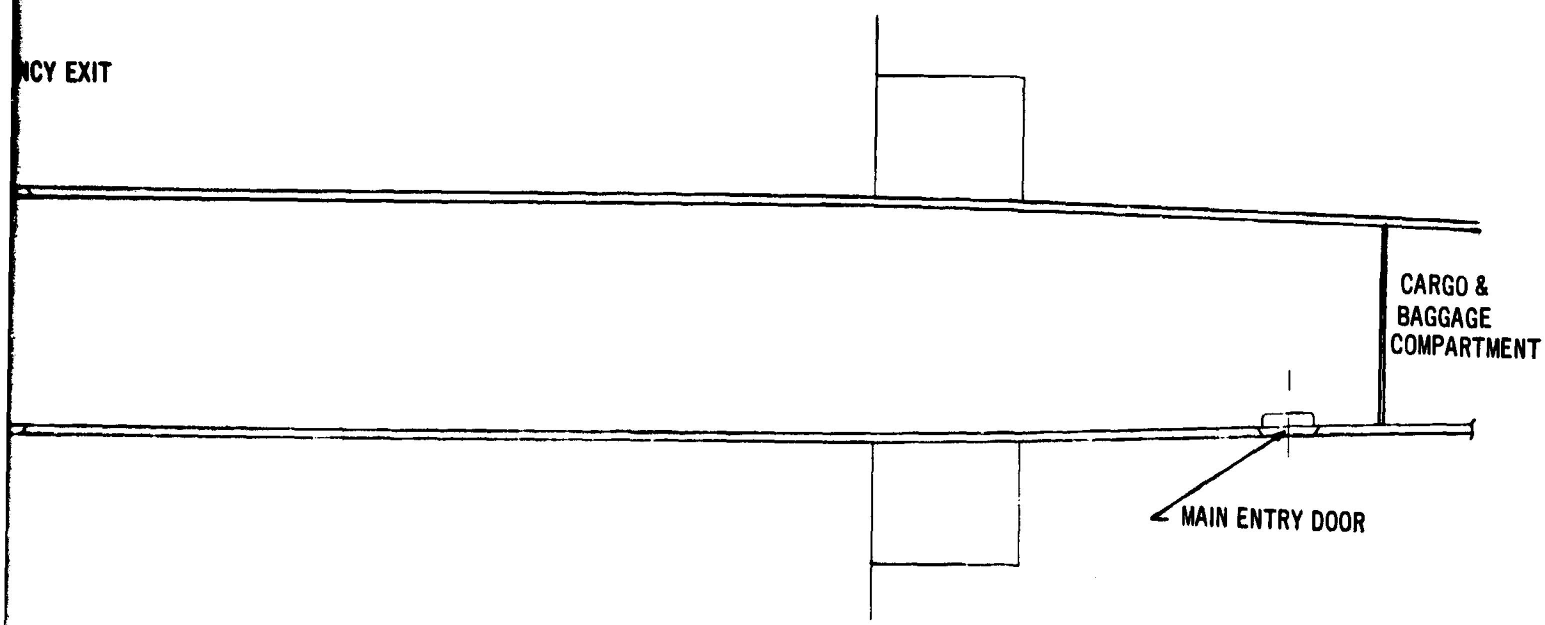
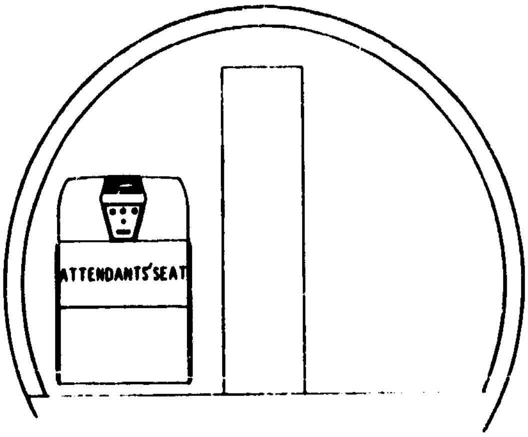
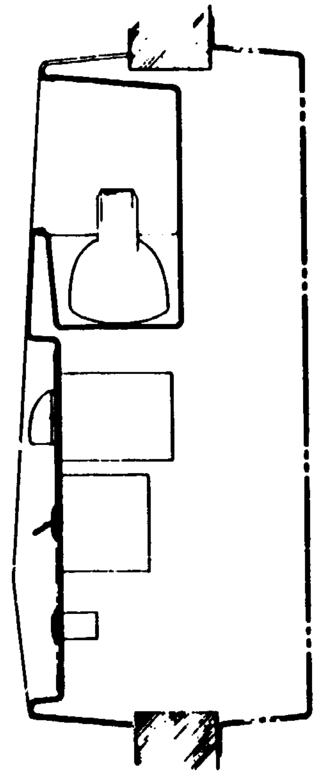



*Fig. S1.11-1 Passenger Arrangement*

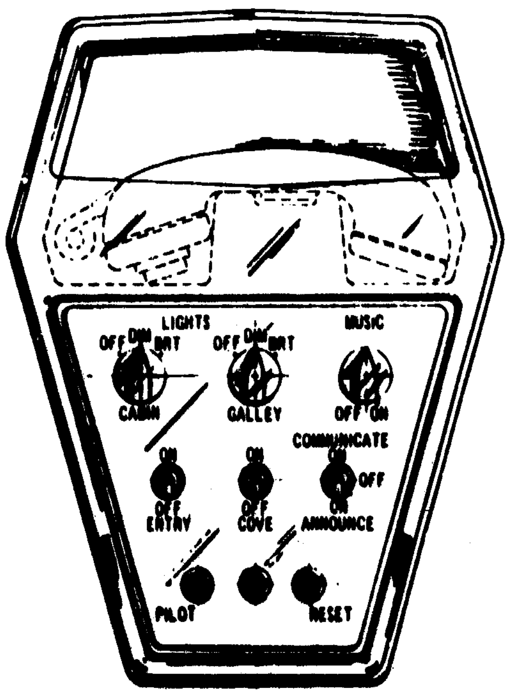
C




TYPICAL PANEL LOCATION



TYPICAL SECTION




FORWARD ATTENDANTS' PANEL

***Fig. S1.11-2 Attendants' Panel***

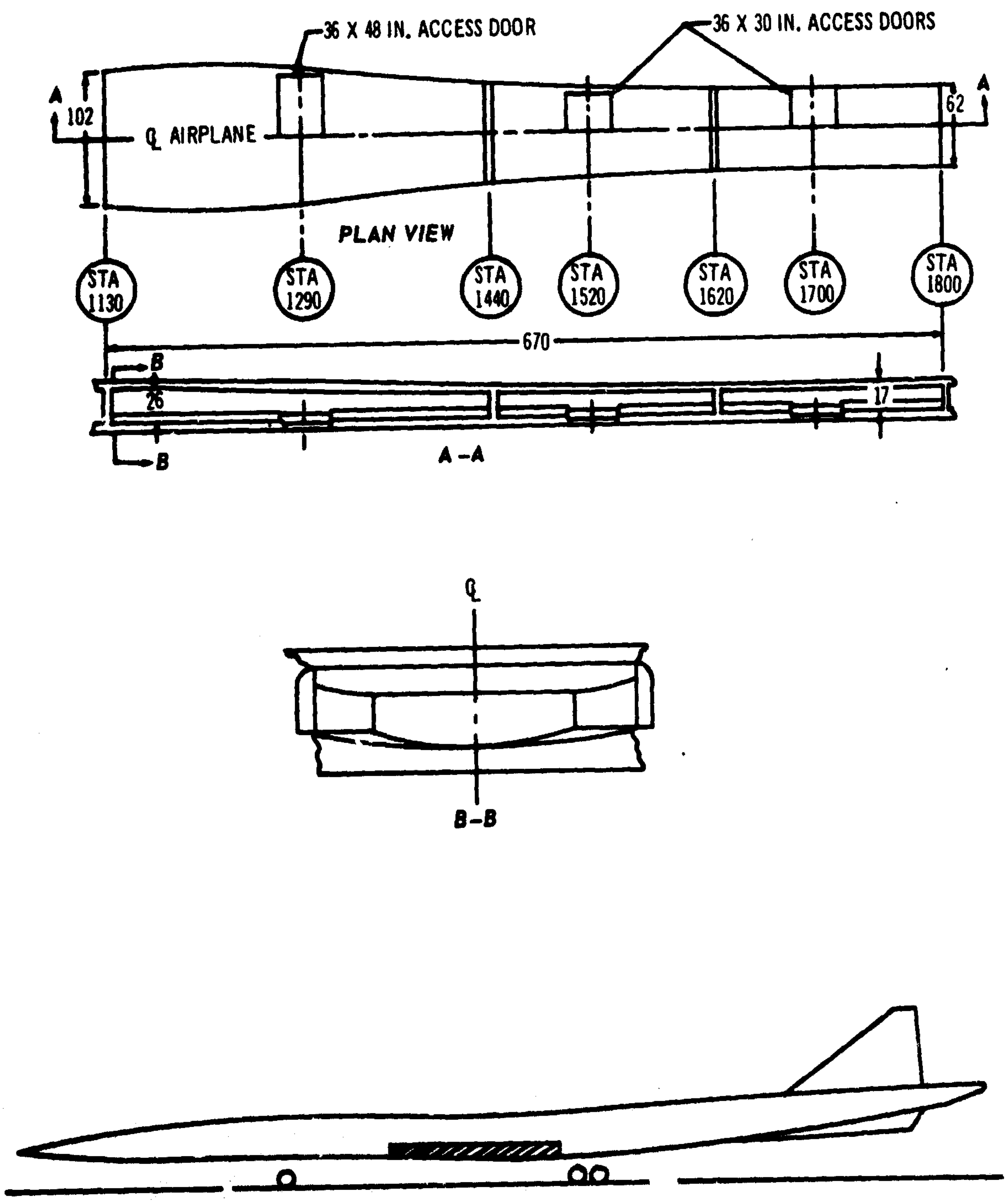



*Fig. S1.11-4 Lower Cargo Compartment*

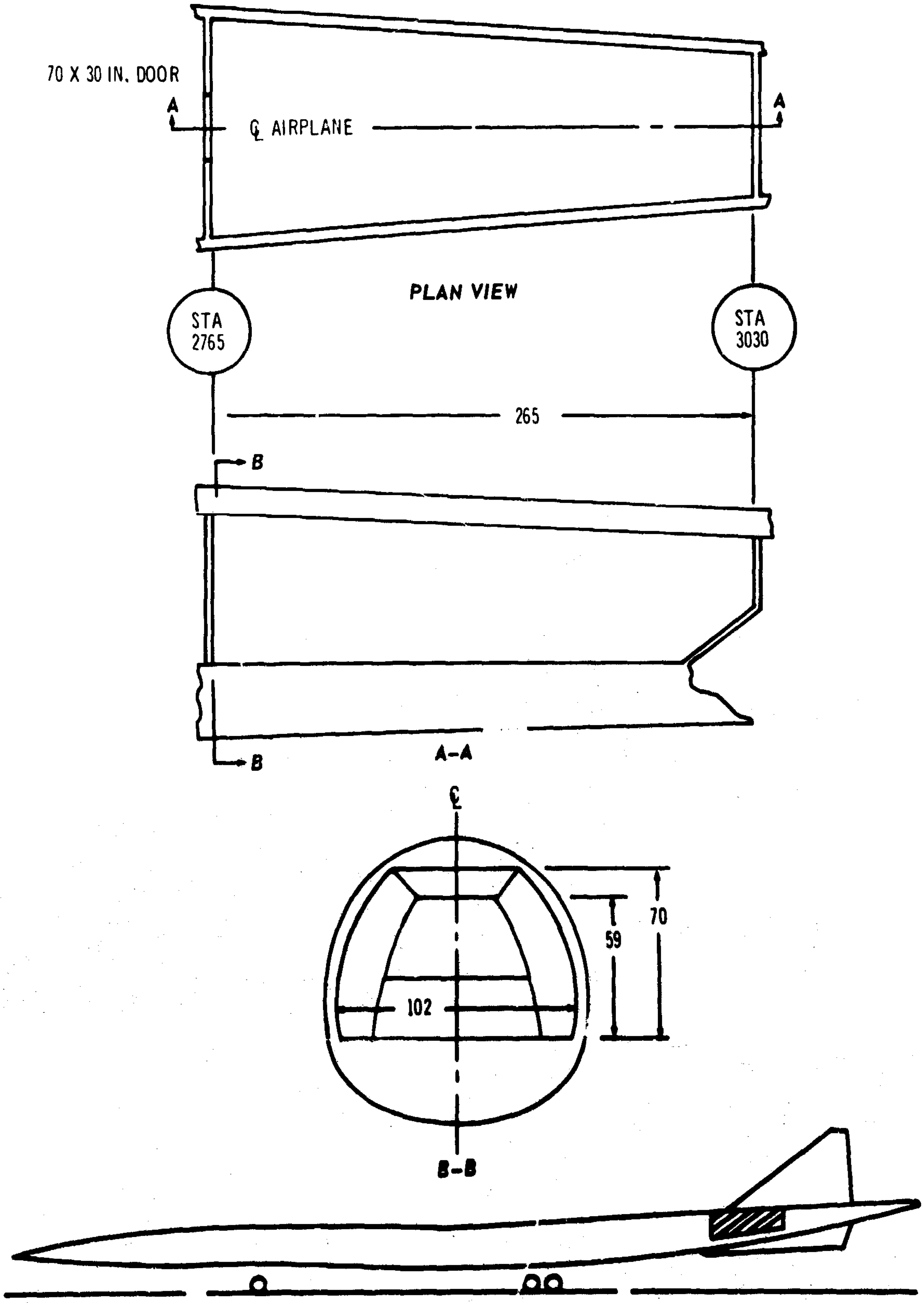
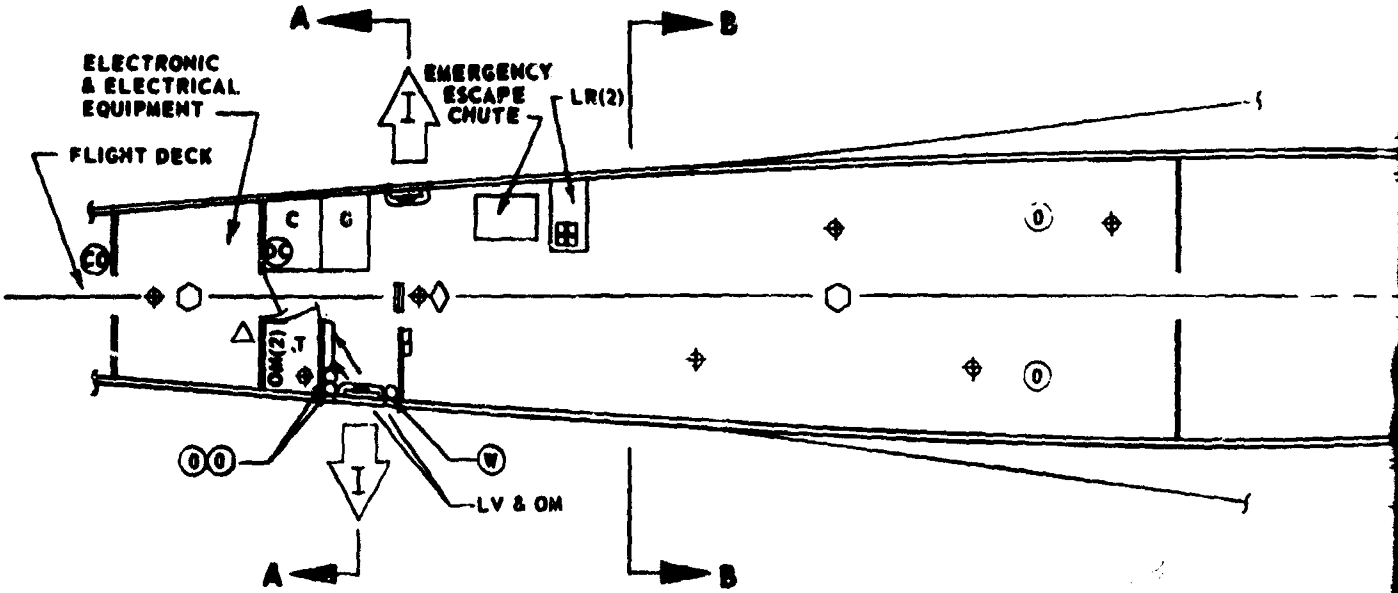
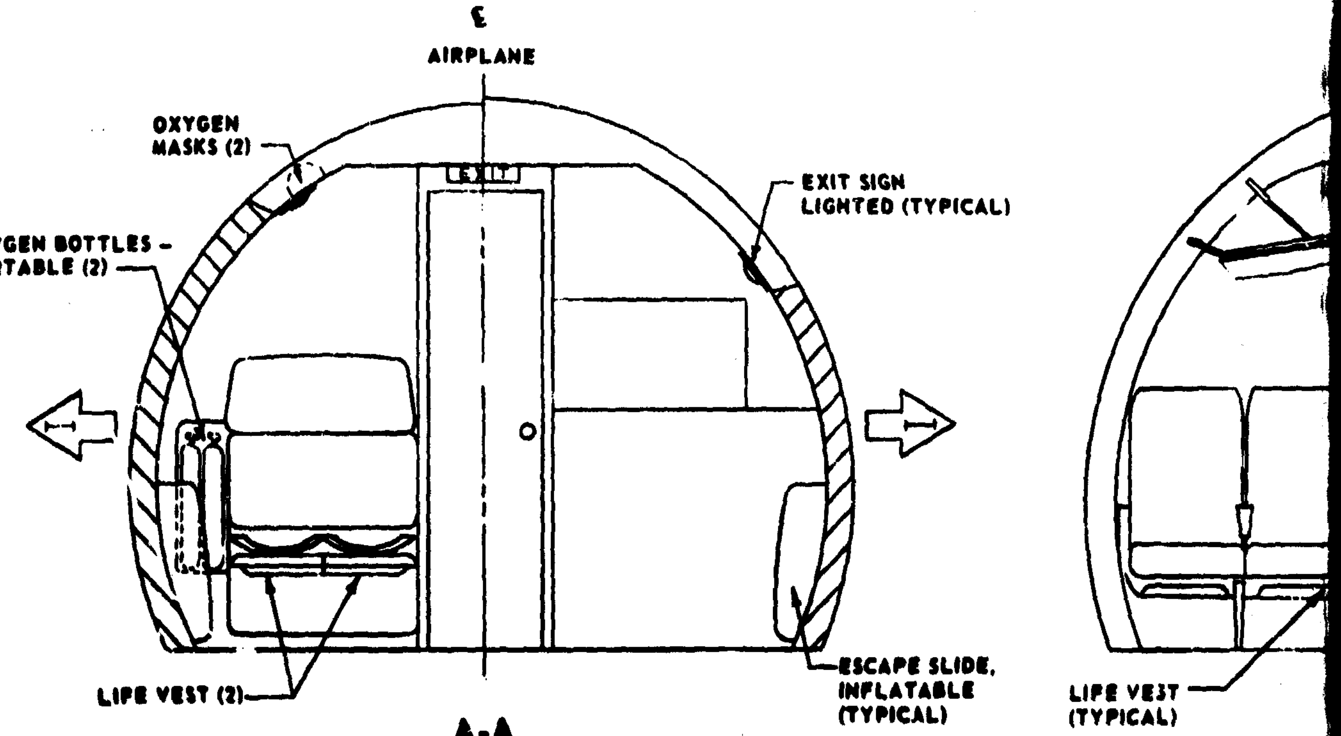


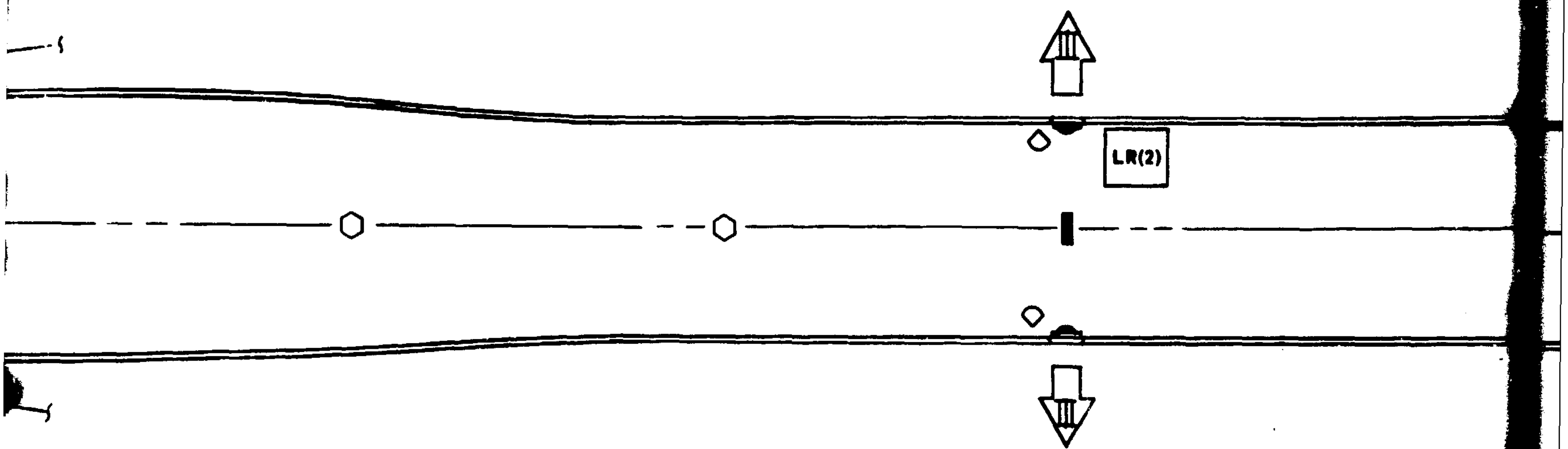

*Fig. S1.11-5 Upper Cargo Compartment*


A
B
ELECTRONIC & ELECTRICAL EQUIPMENT
EMERGENCY ESCAPE CHUTE
LR(2)
FLIGHT DECK
C
G
OM(2)
LV & OM
A
B

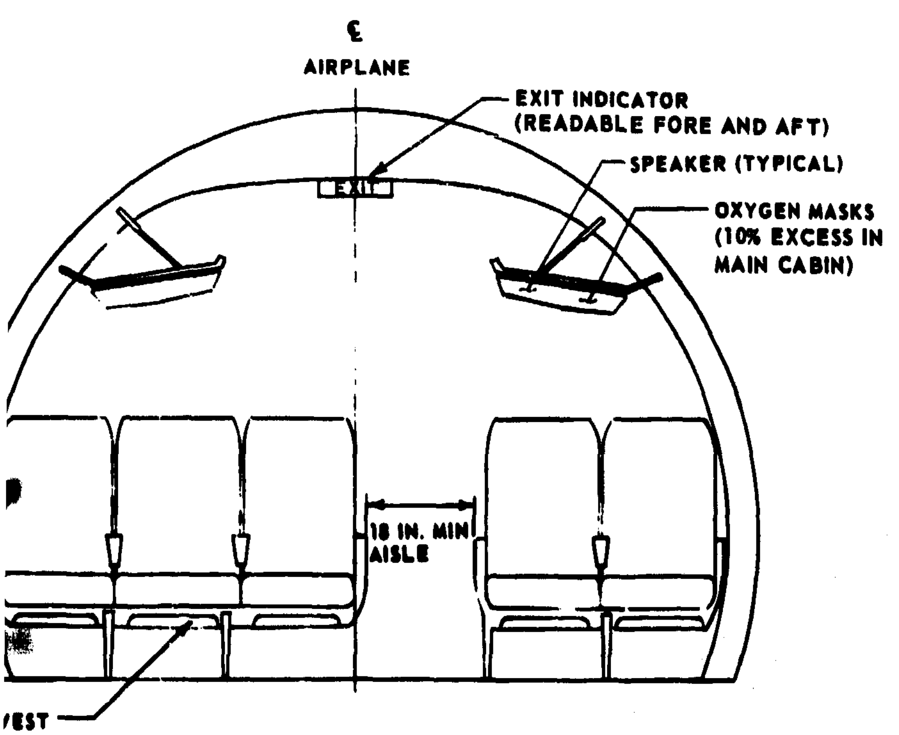

℄ AIRPLANE
OXYGEN MASKS (2)
EXIT
EXIT SIGN LIGHTED (TYPICAL)
OXYGEN BOTTLES - PORTABLE (2)
LIFE VEST (2)
ESCAPE SLIDE, INFLATABLE (TYPICAL)
LIFE VEST (TYPICAL)

A-A

A



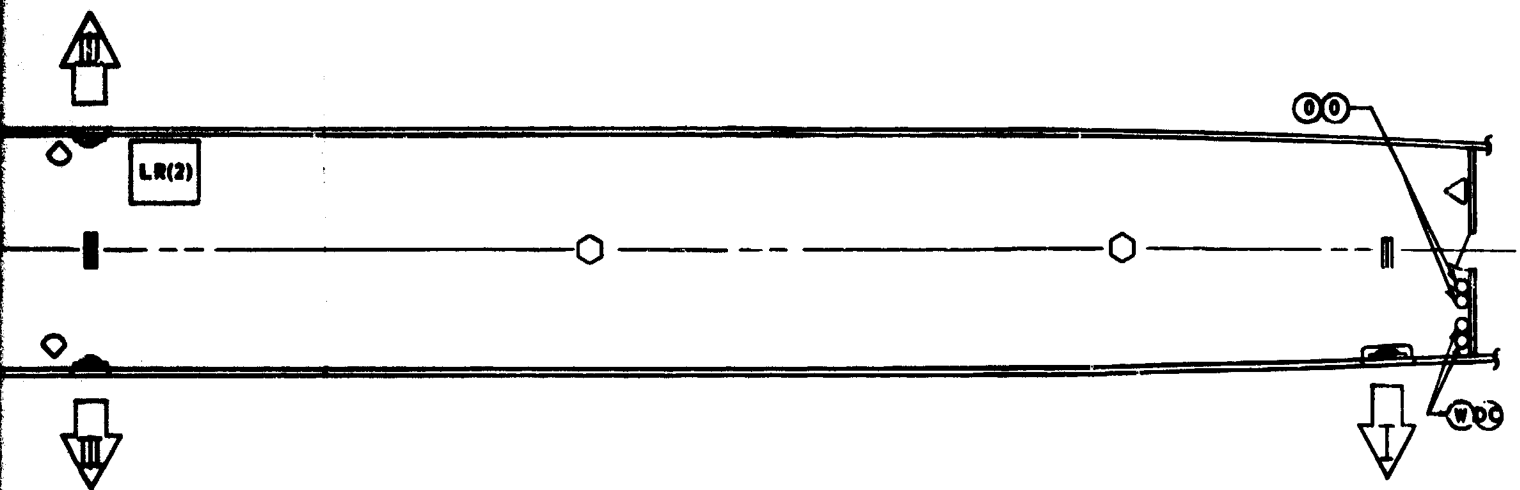

**PLAN VIEW**




**B-B**

*Fig. S1.11-6*

B




- SPEAKER, 4-INCH DIAMETER
- EMERGENCY LIGHT, BATTERY OPERATED
- EXIT INDICATOR, SELF-ILLUMINATED
- EXIT SIGN, BATTERY OPERATED
- SIGN "NO SMOKING–FASTEN SEAT BELT"
- FIRE EXTINGUISHER, DRY CHEMICAL
- FIRE EXTINGUISHER, WATER
- FIRE EXTINGUISHER, $CO_2$ BULLHORN
- CRASH AXE
- ESCAPE ROPE
- MEDICAL KIT AND 7 SPARE LIFE VESTS
- ESCAPE SLIDE, INFLATABLE
- ANNUNCIATOR
- EMERGENCY EXIT, CLASS I
- EMERGENCY EXIT, CLASS III
- OXYGEN BOTTLE, PORTABLE (3.8 CU FT)
- OM — OXYGEN MASK
- LV — LIFE VEST
- LR — LIFE RAFT, 25-MAN, SELF-ERECTING
- T — TOILET
- G — GALLEY
- C — CLOSET
- B — BAR

*Fig. S1.11-6 Emergency Equipment*

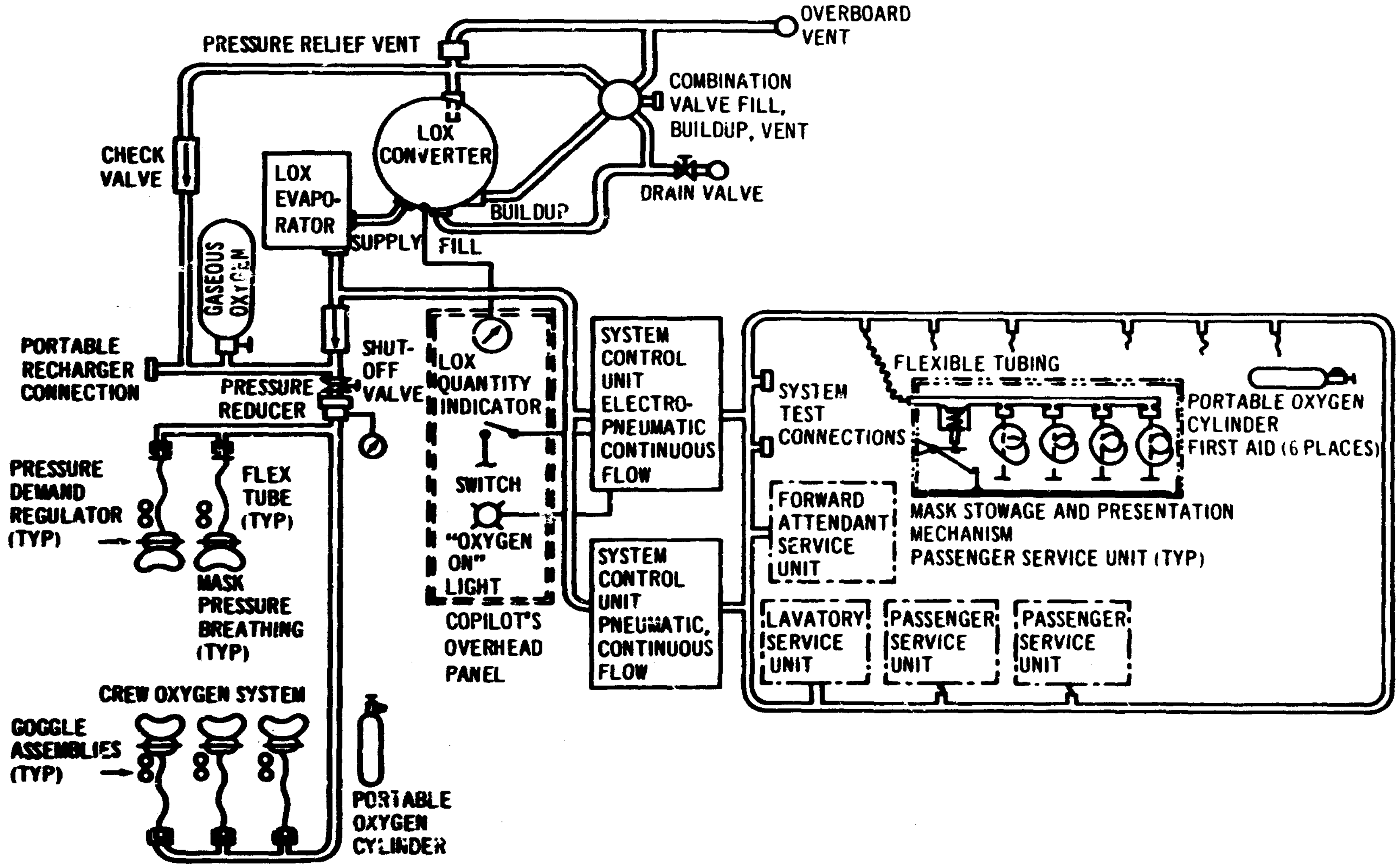



*Fig. S1.11-7 Oxygen System Diagram*

## 12.0 ENVIRONMENTAL CONTROL

12.2.3 Ozone and Radiation Detection

Change to Read:

The air conditioning system shall be designed to limit ozone concentration. Cabin ozone concentration shall not exceed 0.2 parts per million by volume for normal operation, or 0.3 parts per million by volume for short term duration. An ozone concentration measuring system shall be installed with indication at the flight engineer's station.

Test equipment for detecting and monitoring cosmic radiation levels shall be provided.

12.3.1 Cabin Temperature Control Requirements

Add the following paragraph immediately ahead of the last paragraph:

The air conditioning system in the test personnel area shall be substantially identical to that in the passenger area. However, due to differences in equipment installed, the temperature variations noted above for the passenger area will not apply to the flight test area.

# 13.0 MAINTENANCE

## 13.1 GENERAL

Change to Read:

Special consideration shall be given in the design of the airplane to provide maintenance and accessibility features representative of the production supersonic transport. In addition, wherever practicable, the ground operations of the airplane shall be compatible with existing airline practices and ground equipment. To achieve this end, the following objectives shall be considered:

- Design that will ensure minimum through-service, turn-around, and other service downtime;
- Installation of selective automatic checkout systems;
- Minimum ground support equipment;
- Maximum use of existing ground support equipment.

## 14.0 STANDARD PARTS, INTERCHANGEABILITY, AND REPLACEABILITY

Replace entire section as follows:

### 14.1 STANDARD PARTS

AN, MS, and NAS standard parts, including rivets, bolts, screws, nuts, fittings, bearings, etc., shall be used wherever practicable. Boeing commercial standard parts or other commercial parts may be used at the option of the Seller.

### 14.2 INTERCHANGEABILITY AND REPLACEABILITY

Because of tooling and other manufacturing considerations associated with the design and fabrication of the prototype airplane, the interchangeability and replaceability normally provided for commercial production airplanes will not be obtained. However, Boeing recognizes that a degree of component replacement and repair is required for the prototype airplanes. Design and fabrication shall allow for replacement and repair of major components with reasonable down time.

## APPENDIX I

Equipment

### GENERAL NOTES

Change to Read:

This appendix lists selected major items of equipment used on the airplane described in this document.

The Seller reserves the right to substitute equivalent equipment and/or accessories in lieu of those specified herein as Seller-Furnished Equipment whenever such substitution is necessary to improve the product or prevent delay in installation or delivery.

The Procuring Agency's obligations with respect to Procuring Agency-Furnished Equipment are defined in the Contract.

A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

1. INSTRUMENTS

Page AI-5

Replace Items 6, 7, 9, 10, 11, 12, 13, 14, and 15 with the following:

| ITEM | QUANTITY | DESCRIPTION | MAKE | PART OR SPEC. NO. |
|---|---|---|---|---|
| | | FLIGHT INSTRUMENTS | | |
| | | Integrated Flight Control | | |
| | | Instrument System | | |
| 6 | 2 | Indicator/Amplifier, Attitude Director | | BAC 10-60977 |
| 7 | 2 | Indicator/Amplifier, Horizontal Situation | | BAC 10-60977 |
| 9 | 1 | Indicator, Standby Heading/Attitude | | BAC 10-60977 |
| 10 | 2 | Display, Approach Progress | | BAC 10-61083 |
| 11 | 2 | Indicator, Radio Altitude/Vertical Speed | | BAC 10-60979 |
| | | Air Data System | | |
| 12 | 2 | Indicator, Pressure Altitude | | BAC 10-60979 |
| 13 | 2 | Indicator, Calibrated Airspeed/Mach/Total Air Temperature | | BAC 10-60979 |
| 14 | 1 | Indicator, Static Air Temperature/True Airspeed | | BAC 10-60979 |
| 15 | 2 | Indicator, Indicated Airspeed | | BAC 10-60979 |

A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

2. PROPULSION

Delete Item 1

A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

3. ELECTRICAL EQUIPMENT

Change Item 3 to Read:

"4 Reqd Battery, Nickel-Cadmium"

A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

5. AVIONICS

Replace Pages AI-10 through AI-14 with the following pages:

| ITEM | QUANTITY | DESCRIPTION | MAKE | PART OR SPEC. NO. |
|---|---|---|---|---|
| | | <u>EN ROUTE NAVIGATION</u> | | |
| | | <u>Inertial System</u> | | |
| 1 | 3 | Inertial Measuring Unit | | BAC 10-60975 |
| 2 | 3 | Computer, Position and Course | | BAC 10-60975 |
| 3 | 3 | Display Panel | | BAC 10-60975 |
| 4 | 3 | Control Panel | | BAC 10-60975 |
| 5 | 2 | Data Insert Panel | | BAC 10-60975 |
| 6 | 3 | Converter Unit | | BAC 10-60975 |
| 7 | 3 | Battery | | BAC 10-60975 |
| 8 | 1 | Interface Box | | BAC 10-60975 |
| 9 | 2 | Magnetic Azimuth Detector | | BAC 10-60975 |
| 10 | 2 | Compensator | | BAC 10-60975 |
| | | <u>Weather Radar System</u> | | |
| 11 | 1 | Transmitter-Receiver | | BAC 10-60972 |
| 12 | 2 | Control Unit | | BAC 10-60972 |
| 13 | 1 | Antenna | | BAC 10-60972 |
| 14 | 2 | Display Indicator | | BAC 10-60972 |
| 15 | 2 | Indicator Mount | | BAC 10-60972 |
| 16 | 1 | Interface Box | | BAC 10-60972 |
| 17 | 1 | Waveguide Assembly | | BAC 10-61091 |
| 18 | 1 | Radome | | BAC 10-61000 |

A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

5. AVIONICS (Continued)

| ITEM | QUANTITY | DESCRIPTION | MAKE | PART OR SPEC. NO. |
|---|---|---|---|---|
| | | <u>FLIGHT INSTRUMENTS</u> | | |
| | | <u>Radio Altimeter (ARINC 552)</u> | | |
| 1 | 2 | Receiver-Transmitter | Bendix | ALA-51A |
| 2 | 4 | Antenna | | BAC 10-60974 |
| | | <u>Integrated Flight Control Instrument System</u> | | |
| 3 | 1 | Comparator and Approach Gate Monitor | | BAC 10-61085 |
| 4 | 2 | Control Column Shaker | | |
| 5 | 2 | Angle-of-Attack Sensor | | |
| 6 | 2 | Flap Position Transducer | | |
| 7 | 1 | Stall Warning Control Unit | | |
| 8 | 1 | Interface Box | | |
| | | <u>Air Data System</u> | | |
| 9 | 2 | Computer Unit | | BAC 10-60978 |
| 10 | 2 | Total Temperature Probe | | BAC 10-61081 |
| 11 | 1 | Pitot-Static Probe - Dual (Nose) | | BAC 10-61079 |
| 12 | 2 | Pitot Probe (Body) | | BAC 10-61080 |
| 13 | 1 | Interface Box | | BAC 10-60978 |
| 14 | 2 | Transmitter, Wing Sweep | | BAC 10-61082 |
| | | <u>TERMINAL NAVIGATION</u> | | |
| | | <u>Automatic Direction Finder (ADF) (ARINC 550)</u> | | |
| 15 | 2 | Receiver | Bendix | DFA-73A-1 |
| 16 | 2 | Control Panel | Gables | |
| 17 | 2 | Antenna Assembly, Loop | | BAC 10-60973 |
| 18 | 2 | Antenna Assembly, Sense | | BAC 10-60973 |

A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

5. AVIONICS (Continued)

| ITEM | QUANTITY | DESCRIPTION | MAKE | PART OR SPEC. NO. |
|---|---|---|---|---|
| | | TERMINAL NAVIGATION (Continued) | | |
| | | Automatic Direction Finder (ADF) (ARINC 550) (Continued) | | |
| 1 | 2 | Coupler | Bendix | CUA-73A |
| 2 | 2 | Line Stretcher | Bendix | LSA-73A |
| 3 | 2 | Quadrantal Corrector | Bendix | QCA-73 |
| | | VHF (ARINC 547) | | |
| 4 | 2 | Receiver, VOR/LOC/GS | Wilcox | 806A |
| 5 | 2 | VOR/LOC/GS/DME/VHF Communications Control | Gables | |
| 6 | 2 | VOR/Localizer Antenna | | |
| 7 | 1 | Glide Slope Antenna (Dual) | | BAC 10-61087 |
| 8 | 1 | Interface Box - Navigation | | BAC 10-61090 |
| | | Distance Measuring Equipment (ARINC 521D) | | |
| 9 | 2 | Interrogator | Collins | 860E-2 |
| 10 | 2 | Antenna | | BAC 10-61086 |
| | | Marker Beacon | | |
| 11 | 1 | Receiver | Bendix | MKA-28A |
| 12 | 1 | Antenna | | BAC 10-61088 |
| | | SHORT RANGE COMMUNICATION | | |
| | | VHF Communications (ARINC 546) | | |
| 13 | 2 | Transceiver | Bendix | RTA-41A |
| 14 | 2 | VHF Antenna | Boeing | |

A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

5. AVIONICS (Continued)

| ITEM | QUANTITY | DESCRIPTION | MAKE | PART OR SPEC. NO. |
|---|---|---|---|---|
| | | SHORT RANGE COMMUNICATION (Continued) | | |
| | | ATC Transponder (ARINC 532D) | | |
| 1 | 2 | Transponder | Wilcox | 914A |
| 2 | 1 | Control | Gables | G-1316 |
| 3 | 2 | Antenna | | BAC 10-61086 |
| | | Interphone System (ARINC 412) | | |
| 4 | 1 | Amplifier | Telephonics | 20035-1 |
| 5 | 4 | Audio Select Panel | Gables | |
| 6 | 2 | Cockpit Speaker | Gables | G1278A |
| 7 | 5 | Interphone Panel | | |
| 8 | 3 | Handset (Type R500H) | Electrovoice | 6254122 |
| 9 | 4 | Headphone (Type HS-33) | Telephonics | TC 149G |
| 10 | 4 | Microphone | Telephonics | 10065-2 |
| | | Passenger Address | | |
| 11 | 1 | Amplifier | Collins | 346D-2 |
| 12 | 1 | Control Panel | Gables | |
| 13 | 1 | Music Tape Reproducer | Gables | G-825 |
| 14 | Reqd | Loudspeaker (8-inch) Passenger Cabin | Utah Inc. | V5C115 |
| 15 | 2 | Loudspeaker (4-inch) Lavatory and Galley | Utah Inc. | V5C128 |
| 16 | 2 | Microphone | Electrovoice | 602TR-4182 |

A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

2. AVIONICS (Continued)

| ITEM | QUANTITY | DESCRIPTION | MAKE | PART OR SPEC. NO. |
|---|---|---|---|---|
| | | LONG RANGE COMMUNICATION (Continued) | | |
| | | HF Communications (ARINC 533) | | |
| 1 | 2 | Transceiver | Collins | 618T-2C |
| 2 | 1 | Control Panel | Gables | |
| 3 | 2 | Antenna Coupler | | BAC 10-60991 |
| 4 | 2 | Coupler Control | | BAC 10-60991 |
| 5 | 2 | Antenna | Boeing | |
| 6 | 1 | Lightning Arrestor | | BAC 10-60991 |
| 7 | 1 | Antenna Switch | | BAC 10-60991 |
| 8 | 1 | Interface Box | | BAC 10-61089 |
| | | Selective Calling System (ARINC 531) | | |
| 9 | 1 | Decoder | Collins | 456C-1 |
| 10 | 1 | Control | Gables | G-556 |
| | | RECORDER SYSTEMS | | |
| | | Flight Data Recorder System | | |
| 11 | 1 | Recorder Unit | | BAC 10-61069 |
| 12 | 1 | Trip and Data Encoder | | BAC 10-61069 |
| 13 | 1 | Normal Accelerometer | | BAC 10-61069 |
| 14 | 1 | Foil Magazine | | BAC 10-61069 |
| 15 | 1 | Sensor Unit | | BAC 10-61069 |
| 16 | 1 | Spool and Tape | | BAC 10-61069 |
| | | Flight Deck Voice Recorder | | |
| 17 | 1 | Voice Recording Unit | Fairchild | D9300-A101 |
| 18 | 1 | Microphone/Monitor Box | Fairchild | C9300-A153 |
| 19 | 1 | Tape Cartridge Assembly | Fairchild | C9300-A151 |

A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

5. AVIONICS (Continued)

| ITEM | QUANTITY | DESCRIPTION | MAKE | PART OR SPEC. NO. |
|---|---|---|---|---|
| | | AUTOMATIC FLIGHT CONTROL SYSTEM | | |
| 1 | 1 | Autopilot System Dual | | |
| 2 | 1 | Flight Director/Autopilot Mode Selector | | |
| 3 | 2 | Indicator Light, Auto-pilot Disengage | | |
| 4 | 2 | Indicator Light, Auto Throttle Disengage | | |
| | | STABILITY AUGMENTATION SYSTEM | | |
| 5 | 1 | Stability Augmentation System (Triple) | | |

A. SELLER-FURNISHED EQUIPMENT (CONTINUED)

6. FURNISHINGS

Page AI-15

Change quantity of Item 6 from "72" to "7"

Change quantity of Item 9 from "200" to "50"

Change quantity of Item 10 from "2" to "1"

Delete Item 11

Change quantity of Item 12 from "5" to "2"

Change quantity of Item 13 from "3" to "1"

Change quantity of Item 14 from "6" to "1"

Change quantity of Item 15 from "94" to "19"

Delete Item 16

Delete Item 17

Change quantity of Item 18 from "9" to "4"

Change quantity of Item 19 from "9" to "4"

Change quantity of Item 20 from "220" to "60"

Page AI-16

Change quantity of Item 2 from "11" to "6"

Add to Appendix I as follows:

## B. PROCURING AGENCY-FURNISHED EQUIPMENT

### 3. PROPULSION

| ITEM | QUANTITY | DESCRIPTION |
|---|---|---|
| 1 | 4 | Engine, including complete exhaust system, fuel control, pumps, and tachometer generator. Also, Optional Equipment including oil and hydraulic fluid tanks.<br><br>(Engine manufacturer to be determined at a later date.) |

## APPENDIX II

### Manufacturer's Empty Weight Allowances

Delete entire section.

# SUPPLEMENT 2

## Airplane Description - Model 733-394

CONTENTS



R

LIST OF ILLUSTRATIONS

## INTRODUCTION

This supplement is a description of the Boeing Model 733-394 supersonic transport powered by Pratt and Whitney engines.

The definition of the aircraft contained in this supplement has been prepared in the form of a change list in order to provide a compact summary of the differences between the Model 733-390 airplane powered by General Electric engines defined in the basic Model Specification, D6-17850, and the Model 733-394.

Entries in this supplement are identified by the same section and paragraph number under which each subject item appears in the main body of D6-17850. Where no entry is made in this supplement for a specific paragraph of D6-17850, the entire paragraph shall be considered to be applicable to the Model 733-394. Where any portion of any paragraph or section of D6-17850 is considered to be inapplicable to the Model 733-394, this paragraph or section is replaced, revised, or deleted.

Deletion of a principal paragraph or section heading shall include deletion of all subparagraphs or subsections thereunder without individual notation of deletion of each subparagraph or subsection.

## 1.0 GENERAL AIRPLANE DESCRIPTION

1.3 **SELLER'S NAME AND MODEL NUMBER**

Change to Read:

Boeing Model 733-394 Intercontinental powered by Pratt and Whitney engines. (See basic Model Specification for description of Model 733-390 Intercontinental powered by General Electric engines.)

1.4.1 **Structural Design Weights**

Change to Read:

| | |
|---|---|
| Maximum Design Taxi Weight | 510,000 pounds |
| Maximum Design Flight Weight (Flaps Up) | 504,000 pounds |
| Maximum Design Landing Weight | 330,000 pounds |
| Maximum Zero Fuel Weight | 294,200 pounds |

R

Figure 1-1 Replace this figure with Figure S2.1-1.

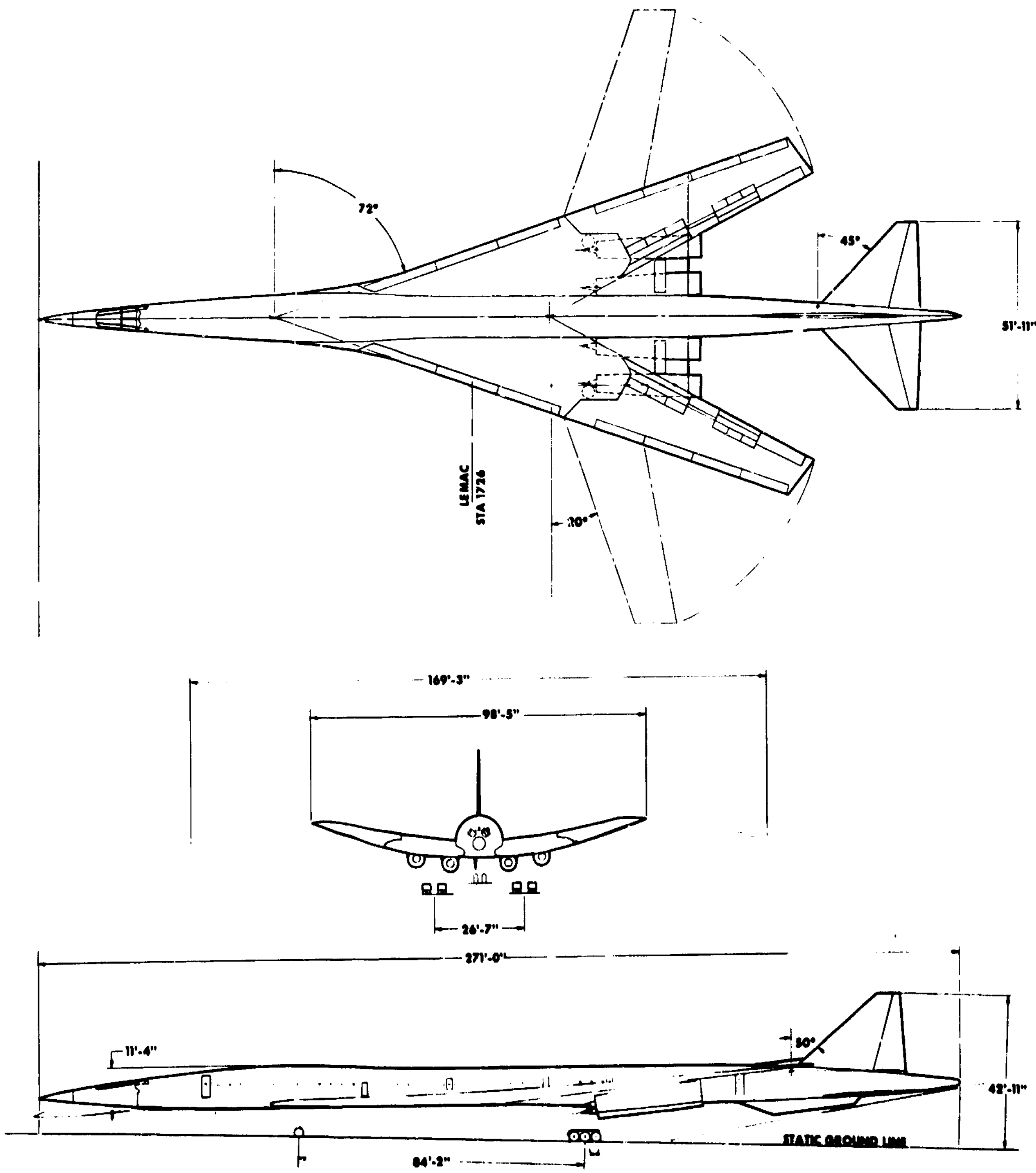

72°
45°
51'-11"
LE MAC
STA 1726
30°
169'-3"
98'-5"
26'-7"
271'-0"
11'-4"
50°
42'-11"
STATIC GROUND LINE
84'-2"

Fig. S2.1-1.

## 2.0 GENERAL REQUIREMENTS

2.2.2 **Supplemental Specifications**

Change to Read:

- Engine Manufacturer's Specification:
  Pratt & Whitney Aircraft Model JTF-17A-20B, Specification 2681 dated October 30, 1964, revised November 1, 1965.
- Electronic Systems and Optional Equipment List
- Electrical Interference Control Requirements, Electrical and Electronic Equipment
- Interior Colors and Materials, D6-6908
- Galley Design and Installation Specification, D6-6954
- Passenger Seat Design Criteria, D6-2556
- Exterior Decorative Markings Specification, D6-6956
- Protective Finishes

## 3.0 GENERAL AIRPLANE CHARACTERISTICS

### 3.10 ESTIMATED WEIGHTS (POUNDS)

Change to Read:

| | | | |
|---|---|---|---|
| Manufacturer's Empty Weight | | | 230,070 |
| Standard Items: | | | 1,975 |
| Unusable Fuel | | 705 | |
| Unusable Oil - Hydraulics and Lubrication | | 250 | |
| Emergency Equipment | | 260 | |
| Oxygen Equipment (Portable) | 44 | | |
| Crash Axes (2) | 6 | | |
| Excape Slides (6) | 210 | | |
| Unusable Water - Washing and Drinking | | 10 | |
| Toilet Water and Chemical | | 150 | |
| Galley Structure (3) | | 600 | |
| Basic Empty Weight | | | 232,045 |
| Operational Items: | | | 4,655 |
| Crew and Crew Baggage | | 1,385 | |
| Flight Crew (3) | 510 | | |
| Cabin Attendants (5) | 650 | | |
| Crew Baggage (8) | 200 | | |
| Captain's Briefcase (1) | 25 | | |
| Usable Oil - Lubrication | | 60 | |
| Emergency Equipment | | 1,500 | |
| 25 Man Life Rafts (9) | 1,125 | | |
| Automatic Emergency Beacon (9) | 45 | | |
| Life Vests (220) | 330 | | |
| Usable Water - Washing and Drinking | | 316 | |
| Passenger Service Equipment (200 Persons) | | 520 | |
| Food and Beverages (208 Persons, Including Crew) | | 250 | |
| Galley Service (208 Persons, Including Crew) | | 624 | |
| OPERATIONAL EMPTY WEIGHT | | | 236,700 |

## 4.0 AIRFRAME STRUCTURES

No changes made.

## 5.0 PROPULSION

5.2.5 Exhaust System

Change to Read:

The complete exhaust system shall be engine mounted. It shall consist of a variable area convergent-divergent ejector nozzle with blow-in doors, an integrated thrust reverser system with a translating exhaust nozzle, actuators, controls and associated plumbing.

Figure 5-2 Delete this figure

## 6.0 FLIGHT DECK ACCOMMODATIONS

No changes made.

## 7.0 FLIGHT CONTROLS

No changes made.

## 8.0 HYDRAULIC AND PNEUMATIC SYSTEMS

No changes made.

## 9.0 ELECTRIC POWER SYSTEM

No changes made.

## 10.0 AVIONICS

No changes made.

## 11.0 PASSENGER AND CARGO PROVISONS

No changes made.

## 12.0 ENVIRONMENTAL CONTROL

No changes made.

## 13.0 MAINTENANCE

No changes made.

## 14.0 STANDARD PARTS, INTERCHANGEABILITY, AND REPLACEABILITY

No changes made.

## APPENDIX I

No changes made.

## APPENDIX II

Change PROPULSION to read:

| | Total Weight (Pounds) |
|---|---|
| PROPULSION | |
| Engines - Boeing-installed weight (4) | 42,640 |
| (P & W JTF-17A-20B, see Par. 2.2.2.) | |